Duplicate

SECOND ANNUAL REPORT

OF THE

STATE MINE INSPECTOR,

TO THE

GOVERNOR OF THE STATE OF OHIO,

FOR THE YEAR 1875.

COLUMBUS:
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ANNUAL REPORT.

Columbus, Ohio, *December* 31, 1875.

To His Excellency Wm. Allen, *Governor:*

Sir: I have the honor to herewith submit my second annual report of the condition and operations of the coal mines of the State, including such other matters and information in connection with mines and mining as I have deemed of importance. At the end of the report I have made a tabulated statement of the number and causes of all fatal and serious accidents during the year; also, a tabulated statement of the coal production of the State, as carefully prepared as I can make it with the means at command.

Many of the coal companies, and their superintendents, refuse or neglect to furnish information at the time of the occurrence of both fatal and serious accidents, there being no penalty attached to the law for failure to comply with its provisions in this regard, and all the accidents are not reported as promptly as they occur.

A large number of accidents occurring in mines are caused by falls of roof and coal in the working places of the miners. Such accidents are generally the result of causes for which the coal companies, or their agents, are in no wise responsible. They are due to the perils of the mine, and their number can only be lessened by increased care and skill on the part of the miners themselves. In his working place, the miner has absolute control, except in furnishing prop-wood, and any neglect on the part of the mine-owner to furnish prop-wood ought to render him responsible for accident; but in the matter of excavating the coal, and securing the strata overhead—work ever fraught with more or less peril—the miner alone is responsible for accident occurring to himself, and no one but himself can assume such responsibility. In providing against all other dangers, however, the miner must rely on others. The timbering of the slope, shaft or drift; the machinery for raising and lowering the miners; the safety of the traveling-ways from the bottom of the mine to the distant chambers in the interior; the sweeping away of the foul gases, etc., are in the hands of the managers of the mine, and the miner has no power to remedy any existing defect or danger in any of these arrangements. Even if he had the power, he has no means of knowing that there is danger, for his business is to hew out the coal at the wall faces, not to inspect the mine.

Although all good mining engineers hold that it is true economy to provide and maintain elaborate arrangements, from the commencement of underground excavations, for the security of the mine and the health and safty of the miners, it requires immediate outlays of money to do this, which too many coal companies and their bosses seek to evade. A small ventilating furnace is constructed, where a large one is needed, to save brick and fuel; narrow air-ways are driven, or air-courses are neglected altogether, because it costs money to provide more timely and elaborate arrangements for the maintenance of a vigorous and healthy ventilation. A single mode of entrance and exit is made to the mine because it costs double the money to make two.

When the law providing for official supervision of the mines was enacted, a large number of the mining operators of the State seemed to regard it as an invasion of their rights as proprietors, and asserted that its operations would result in crippling the mining industry of the State. This fear arose from a want of true mining knowledge. The great majority of these operators, although having invested hundreds of thousands of dollars in mining concerns, practically know nothing of the inside departments of mines. They seldom venture into the interior, and when they do, have to be led through the many labyrinthian passages by the mine boss, or by some other subterranean guide, as a child in a strange city has to be led by its father. This is practically the case in the shaft-mining regions, and where the coal seam is so thin as to cause the explorer to assume a stooping position the whole length of the way. The law came not to impose oppressive restrictions on the business of mining, but to put into practice improvements in the art of mining, which would be to the benefit of both parties in interest; for all experience goes to prove that money spent in making a mine safe and healthy is, after all, money saved. The requirements of the law are no more than the application of approved mining knowledge, which seeks to save, not to destroy. Not a few of the miners also had equally selfish and mistaken views in regard to the object of the law, and the manner in which it should be enforced. They looked for and demanded immediate and uncompromising interposition on the part of the Mine Inspector, overlooking the fact that time was necessary to make needed improvements, and that in many cases the parties in charge of the mines had to be instructed in sound principles and good practice before the law would avail.

During the year many noteworthy improvements have been made in conformity with the law, and no mine has ever been made safer or healthier to the regret of the owners or the responsible managers. There is a growing desire to drive double entries for ventilation, and all the new mines opened during the year, and since the law went into operation, have been laid out on this plan. On the other hand, there is yet a large number of mines in which too little improvement has been made, and if they are not in better condition at the time of the next visit, I shall be obliged to apply to court to enjoin or restrain them from operating with more than ten men at once, until they comply with the requirements of the law.

During the year one third of the mines were not visited at all for want of time. There are nearly three hundred different openings in the State that come under the provisions of the statute, and no one man can get round them all, and make a thorough and careful inspection of their condition, in less time than fifteen to sixteen months; and even then he must be constantly in the field. Mines which I knew, or had good reason to believe, were in a safe and healthy condition were passed over, and attention given to those requiring inspection and improvement.

In passing over the mining regions of the State, I have invariably urged the miners to communicate with me freely, and to promptly inform me, in all cases, where the law was not being carried out; to write nothing but the facts, and to sign the name of the writer to the letter. I frequently receive anonymous communications containing complaints, the writers setting forth that if their names were known they would be discharged. In most of such cases investigation has proved that a private grudge lay at the bottom of the complaint, and I have resolved to give them no attention in the future. No man has ever been discharged for writing me. Indeed, a coal company could not make a greater mistake than to discharge a man for doing so.

COSHOCTON DISTRICT.

In the month of January I received a letter from a miner working for the Home Coal Company, in Coshocton county, complaining of bad air, and asking for an inspection of the mine. The air was found to be very bad, and I directed the superintendent to make the necessary improvements. He promised to do so, but, on my leaving the premises, neglected the matter, and I soon received a second complaint. The superintendent, himself a practical miner, and one of the owners of the mine, urged that the miners were unreasonable, and that there was no cause of complaint. I requested him to accompany me through the mine, which he did, and he not only acknowledged that there was good ground for complaint, but went resolutely to work to improve the condition of the mine. I urged him to change his system and drive double entries, but he declared that the margin on the coal was too small to meet the increased expense. He, however, built a new and improved ventilating-furnace, overhauled all the air-passages, closed up all the leaks, and so improved the ventilation that the miners felt satisfied and grateful. I made a second visit to the mine during the summer, and its condition was still very praiseworthy.

The mine of the Coshocton Coal Company was also inspected at this time, and there was bad air prevailing. The mine had been idle for some time, and had lately received a new mine boss. He promised that arrangements would at once be made for the proper distribution of the air, and that all cause for complaint would be removed, which was done.

The Pen Twyen mine was provided with an abundant supply of air, but it was not as well carried around the mine as it should have been. Several of the entries were too far ahead in the fast, and the miners were working in an impure atmosphere.

Some mines were working at Franklin Station, on the line of the Pan-Handle Railroad, but they were not inspected, and several others of the district were idle at the date of visit, and were passed. All of the mines of this district make white-damp, a gas amidst which a miner's lamp will burn with great clearness, even where the miner himself could not live an hour. This gas comes from the gob-waste, the slack-coal of which contains the elements of spontaneous combustion or "breeding fires."

The coal on which these mines are opened is from three to five feet of thickness, and is a bright, clear coal. It is located as No. 6 by Dr. Newberry, but I am disposed to believe that it is a bed lower down in the series, and is the equivalent of No. 4 of the geological nomenclature. The horizon of No. 6, as it seemed to me, was fully one hundred and thirty feet higher, and as the strata above the coal, in course of extraction, was less than this thickness, No. 6 has no existence in the district. From eighty to ninety feet above the Coshocton coal there is a thin bed near the top of the hill, the equivalent of No. 5, and the place of No. 6 would be about fifty feet higher up.

The mines of this district are opened on a synclinal curve of the strata. The main entries are pushed forward in the lowest place of this hollow, where the height of seam is greatest, and the means of drainage the most perfect.

THE DENNISON DISTRICT.

The mines of this district are located in the Tuscarawas valley, mainly on the line of the Pittsburgh, Cincinnati and St. Louis Railroad, and on the Cleveland and Tuscarawas Valley Railroad. They are all level-free, with the exception of one shaft 110 feet in perpendicular depth, which is not running at present. Three different seams of coal are opened, Nos. 4, 5, and 6. The shaft alluded to above is opened in No. 4. The block-vein colliery is opened in No. 5, and all the others are in No. 6. The system of working the mines in general practice is the same rude and faulty one prevailing in many other regions of the State—that of driving single entries, and relying for ventilation by opening cross-cuts through the rooms. The result is that here, as elsewhere, the entry-men, and all the other workmen opening rooms, seldom have air fit for the abode of the miner. After the rooms are fairly opened, if doors and stoppings are timely provided, the air may be above complaint, but it is never as pure and sweet in the entries as it ought to be. The object in working a mine on this plan is to save the cost of driving air-ways or double entries. When every disadvantage is considered, and the expense added of hanging and keeping up trap-doors, there is no real saving effected. Every mine superintendent who has adopted the system of driving two entries on parallel lines, and keeping them well abreast, is so well satisfied with the change that he could not be induced to return to the primitive method.

The mines of O. Young & Co., at Pike Run, opened on the single-entry system, were in as fair condition as such mines generally are, but the entry-men had no air. Their lights could be maintained with difficulty, owing to the presence of black-damp in the mine atmosphere. I suggested to the pit boss to stop several of these places until a better atmosphere was provided, which he did. I urged him to adopt the plan of taking two entries forward instead of one.

The Andreas mine of S. W. Andreas & Co., near the village of Urichsville, was opened up on a different system from that of any prevailing in the State. The entries had all been pushed to the boundary of the coal property before any of the rooms were opened. The mine was then laid out in a series of blocks, by cutting galleries for air and drainage from one butt entry to another. The blocks at the extremity of the mine were first worked. After the rooms were finished the pillars were attacked, and the roof allowed to fall down. In this manner fully nine-tenths of all the coal was being recovered. The great drawback to this plan is the time required to drive the entries to the extremity of the coal property before any returns are made on the capital invested, and this disadvantage will always forbid its general application.

The mines of the Stillwater Coal Company were not in operation at the date of my first visit to the Dennison district, but on the second visit were inspected. They were in fair condition, or changes were in progress to make them so. None of the other mines of the district were working, and so were not examined.

Near the village of Port Wasbington the Glasgow and Port Washington Iron and Coal Company have opened two coal mines, one on No. 6 and one on No. 7. The blackband ore is mined in connection with No. 7, the ore forming the roof of the coal. Neither of these coals at this point have proved to be well adapted for smelting the ore, even after being coked, and this company was using Connelsville coal in their furnaces.

THE STEUBENVILLE DISTRICT.

These mines refer to the shaft openings in the neighborhood of Steubenville. They range from 180 to 261 feet of perpendicular depth, and are the deepest coal mines in the State. A single visit to this district is sufficient to know that they are well and skillfully managed. The underground workings are modeled after those of the Newcastle district of England—a coal-field in which the art and science of coal mining is better understood than in any other coal region of the globe.

The mines of Steubenville make fire-damp, but so perfect are the ventilating arrangements that the gas is diffused through the atmospheric air and swept away as rapidly as it is evolved from the coal strata, and its presence is seldom seen in any of the working places of the miners. The mines are, however, examined every morning by a corps of experienced fire-viewers before any of the miners are allowed to descend, and nothing is left to miscalculation or to accident. Timely and elaborate arrangements are made for the creation and maintenance of an abundant supply of air to all the ramifications of the mines. The furnaces, air-passages, up-cast and down-cast arrangements, are all roomy, and bear proper proportion to each other, so that the best results are attained. The miners never complain of bad air in this district. The underground manager of the Boreland shaft reported 46,000 cubic feet of air per minute as circulating through the mine, the underground force being less than 100, making a column of air of 250 cubic feet per man per minute.

The Rolling Mill shaft and the shaft of the O. and P. Coal Company have also strong currents of air moving through the mine. They were not measured, and so the amount can not be given, but it was all-sufficient. The Rolling Mill shaft has a furnace and the exhaust steam from a No. 6 steam Cameron pump to produce rarefaction; the O. and P. shaft a furnace; the Furnace Company's shaft exhaust steam alone—too weak a power for a large mine—(this was a new opening, however, and the force of men was small at date of visit); the Mining and Coal Company a furnace; the Boreland shaft a furnace; the Bustard shaft a furnace; the Mingo shaft a furnace; La Grange exhaust steam (a new mine); and Rush Run a double furnace. All these furnaces were unusually well constructed, and the fire constantly maintained.

The manager of the Stony Hollow shaft and the Market Street shaft has sent me a monthly report of the amount of air in circulation. These two mines, belonging to one firm and managed by one engineer, are three-fourths of a mile apart, and are holed through on each other, one serving as a down-cast, the other as an up-cast shaft.

The following is the monthly statement, being equal to 500 cubic feet per minute per person employed:

January	65,000	cubic feet per minute.
February	62,824	" " "
March	55,940	" " "
April	59,070	" " "
May	50,060	" " "
June	48,640	" " "
July	50,456	" " "
August	56,570	" " "
September	62,990	" " "
October	67,212	" " "
November	68,925	" " "
December	53,250	" " "

None of the other mining bosses have sent me monthly reports. All bosses in charge of mines in which fire-damp abounds are required to do so by the statute, but as there is no penalty attached for neglect or refusal, it is simply optional with them whether they do so or not.

Mingo's shaft, situated below Steubenville, works a very small force of men, and does not come under the act at present. The mine is well opened, and has ample ventilating power, though it has but one means of ingress and egress.

The shaft of the Steubenville Furnace and Iron Company had also but one means of exit; but at the date of visit the excavations were not equal to what the law requires before two openings must be provided.

Further up the river there are two abandoned shafts lying full of water. Both of these openings have been filled up, and no record of the excavations has been preserved. It is thought that in one pit about three acres of coal have been mined, and in the other about one acre. If the Furnace and Iron Company propose using any of these shafts for a second opening, they should reopen the pit, pump out the water, and work from both shafts. Unless the water is pumped out, great caution will be necessary in working forward toward these old works, and bore-holes should be kept in advance of the excavations as a measure of safety.

The Furnace shaft has been sunk on the ancient bed of the Ohio River. Although one hundred and ten feet deep, it has only about twelve feet of shaly strata above the coal. The Company have unwisely commenced mining out a section of the coal near the bottom of the pit. Where there is so light a cover, all this coal should have been left until the mine was being finished up. A break in the roof in this excavated portion might discharge such a current of water as to submerge the colliery and imperil the safe exit of the miners. All the workings in this part of the mine are now suspended.

The ventilating power of this mine is the exhaust steam from the steam-pump placed at the bottom of the shaft. This power will be wholly inadequate in summer weather as the workings extend, and as it would be impossible to use a furnace, owing to the wood-work of the shaft reaching nearly to the bottom, an exhaust fan ought to be applied, if the present upcast compartment of the shaft is to be used in future.

Two other mines, the Bustard shaft and the Allikanna shaft, both of which were idle during my former visits to this region, are now at work. They have each but one opening, but they are at present working a very small force of men. It has been proposed to drive through from the Bustard shaft to the Furnace shaft, to provide double means of exit to each of these mines.

On the cages of the Rolling Mill shaft there were two different kinds of safety-catches, both patented since the passage of the mining law. I made four thorough tests of each, and they proved entirely satisfactory. Either of these catches may be applied to a coal shaft with entire confidence. I shall make further tests from time to time, and prove, by actual practice, the length of time they will run before the springs require to be renewed.

The Market Street and Stony Hollow shafts are holed through in each other, which make double outlets. The Rolling Mill shaft, the Ohio and Pennsylvania shaft, and Boreland's are all through in each other. The workings of the Rolling Mill shaft have been pushed under the Ohio River, but they are now abandoned in that part of the mine because of the danger of the river bursting in and drowning the colliery.

The shaft of the Rush Run Coal Company has also but one opening, but the superintendent of the mine had, before the time of my visit to the district, reduced the working force of the mine to ten men, until such time as the two openings would be provided. Part of the workings of this mine also extend under the Ohio River a distance of fifty yards or more.

The shaft at the village of La Grange, owned by Messrs. Lowe & Spaulding, and superintended by John Lowe, has also but one opening. It is, however, a new mine, and does not come under the provisions of the law. This is the deepest coal shaft in Ohio, being two hundred and sixty-one feet of perpendicular depth. It is lined throughout its whole length with wood. The cages are covered, safety-gates provided, and a speaking-tube applied. The coal of this mine is upward of five feet high, while at Rush Run, further down the river, it is still higher, locally rising to seven and eight feet.

The mines of this district are all opened, it has been thought, in one seam of coal (No. 6 of the Geological Survey). This is the view held by Dr. Newberry. While it is with extreme diffidence that I venture an opinion at variance with that of so able a geologist, I would suggest that the Rush Run and La Grange shafts only are opened in No. 6, and that Mingo's, Boreland's, the Rolling Mill shaft, and the other shafts in the neighborhood of Steubenville, are sunk in No. 7. At the Stony Hollow shaft of the Steubenville Coal and Mining Company the seam is nearly four feet in height; at Boreland's it is only three feet five or six inches; and at Mingo's it has thinned down to twenty-six and twenty-eight inches. In the La Grange shaft, the next one below Mingo's, there is a seam of coal fifteen inches in thickness twenty six feet above the bottom of the five-feet coal. This upper coal I regard as the equivalent of Mingo's, Boreland's, the Rolling Mill shaft, etc. Forty-four feet below the coal of the Rolling Mill shaft there is another seam four feet four inches thick, to which the mine-owners have sunk within the last six months; and this, it seems to me, is No. 6, the equivalent of the La Grange shaft coal and of the Rush Run shaft coal—No. 7 having thinned out to a mere trace at Rush Run.

The Mingo Iron Works Company, the owners of the Mingo shaft, have driven entries in all directions in thin coal, hoping to strike a thicker field. They have been encouraged in this hope from seeing a workable seam of coal in Boreland's, on their right, and a workable seam at La Grange, on their left; but if the thin coal, near the bottom of La Grange shaft, be the equivalent of Mingo's and Boreland's, it will be to no purpose to make further explorations in this seam, but to explore by sinking for the equivalent of the coal of La Grange shaft and the lower coal of the Rolling Mill shaft, which should, and doubtless does, exist at a depth below the bottom of the Mingo shaft of from twenty-six to forty-four feet. Even should No. 6 be wanting at this point, which is highly improbable, for it is every where a very persistent seam, there is still hope for finding other coals by going deeper.

BELLAIRE DISTRICT.

This coal region includes the mines opened along the Ohio River in the Pittsburgh coal, or No. 8, beginning with the Walnut Hill mines of the Ohio and Pennsylvania Coal Company, at Tiltonville, Jefferson county, extending thence twelve miles below Bellaire to the mines of the Union Coal Company, in Belmont county. The Ohio River flows along the dip of the Coal Measures. The Tiltonville and neighboring mines are high up in the hills fronting the river, while the Union and Pipe Creek mines are below the bed of the Ohio.

The Walnut Hill mines of the Ohio and Pennsylvania Coal Company, at the date of inspection, April 10, were in a deplorable condition in regard to ventilation. The miners had been compelled to stop off work for want of air; and so defective was the ventilation, that a lamp could with difficulty be kept burning in nearly every working place. The mine had two openings, but had no means of creating a flow of air, except the natural forces; and the interior of the mine had no proper arrangements for distributing the air at the working faces. The superintendent of the mine was busy erecting a furnace at the outside of an old opening. The grate of this furnace was too small for any good results, and the passageway of the chimney for the ascending column of heated air was less than a foot square. I informed him that such a structure would serve no purpose whatever—that he was simply spending time and money for nothing, and urged him to commence the sinking of an air shaft at once, and at the bottom of it erect a large and spacious ventilating furnace. He, however, went on with his present arrangement, and when it was completed there was still no flow of air in the mine. Even if this rude furnace had given any motion to the air, the working places of the miners would not have been benefited as they should have been, for want of the necessary arrangements to discharge the current at the working faces where the people are employed.

I wrote to the general superintendent of the company in Cleveland, urging him to send the manager of the Ohio and Pennsylvania Coal Company's shaft at Steubenville, Mr. John Smurthwaithe, to superintend the ventilation, and to give him charge over all the ventilating arrangements of the mines of the company. Mr. Smurthwaithe was one of the best practical miners in the State, and was especially skilled in mining ventilation. He has since died, and in his death Ohio has lost a man of whom there are too few to be found. This worthy man was equally skillful in the management of miners, by whom he was highly regarded. Throughout the whole of the Steubenville district there is less bickering and fault-finding with the mining captains on the part of the working miners than in any other mining region in the State, and this fact is to be attributed to the superior ventilation prevailing. Amidst the foul and noxious elements of the mine, what miner can respect that captain whose duty it is to keep the air clean and sweet, and allows it to be for ever foul and poisonous?

The Rainey mines were inspected by the proprietor's request during a second visit to this region. The ventilation was good, and proper means of ingress and egress were provided. These mines had been leased for some years previous to a firm in Cleveland, and a number of the rooms had fallen in, caused by a crush of the rocks overhead. The safety of the miners was assured in case of any sudden and immediate falling in of the mine. The falling of the roof in the rooms was due to a local crush of the overlying rocks. In accordance with the prevailing system of the district, the rooms were made wide and the pillars narrow, with the object of finishing up the mine in the first stage of working, and leaving all the pillar coal unwrought, to be lost for ever.

The mines of Heatherington & Brothers, near Bellaire, are more systematically managed than any others, both as regards ventilation and the ultimate recovery of the coal. The air is exceedingly well distributed, and the miners expressed gratitude for the sanitary condition of the mine.

Several mines are opened on the line of the Baltimore and Ohio Railroad, west of Bellaire. They are drift openings. Kidd's mine was examined. It worked fourteen men, had a fair state of ventilation, and was in other regards secure. There is a slip-dike in this mine, which throws up the coal three feet. This fault, although of little depth, compared with slip-dikes in many coal fields of the world, is one of very unusual depth in Ohio, and is the largest I have seen in any coal mine in the State. Another mine, west of Kidd's, working more than ten miners, was visited, but was not inspected.

The Pittsburgh Works, the Weegee mines, the Union Coal Works, and the Pipe Creek mines are all slope openings, situate below Bellaire, on the Ohio River. They were all visited and inspected. The Pittsburgh slope was being pushed towards a point with one of its galleries, in order to get a shaft sunk in suitable ground for a double mode of ingress and egress, and to provide better ventilation. The owners of the mine proposed to put a stairway in this shaft. The mine had two openings already, but the air-shaft, although situate more than one hundred feet from the bottom of the slope, came up directly by the side of the slope mouth, and as the wooden structures covering the hoisting machinery were near the slope mouth, there was no guarantee of safety in case of fire in these buildings, but when the new air-shaft is completed there will be approved means of egress in case of accident, and also an improved ventilation.

The slope of the Union Coal Company is one of the most skillfully opened mines in the State. The entrance to the slope mouth, and the passage downwards to firm and rocky strata, are secured by an arch of stone masonry, substantially erected, and the passage-way of the slope is double. The length of the slope is 428 feet. The air-shaft of this mine also bore marks of skillful and prudent workmanship. The passage to the ventilating furnace was lined on both sides, for several yards, by a wall of stone masonry, to prevent the possibility of the pillars taking fire from the heat of the furnace.

The Pipe Creek mines, situate at the mouth of Pipe Creek, are the lowest openings on the Ohio River, of the Bellaire district. This mine was working about thirty men at date of visit, was provided with two openings, but, as at the Pittsbugh Works, the mouths of the slope and air-shaft are too near each other for safety. The ventilation was fair.

The manner of laying out the workings is generally very faulty all over this district. The rooms are made too wide and the pillars too narrow. The ultimate result will be, in many cases, a crush or creep of the mine excavations, which will overrun and destroy the whole economy of the underground workings. The overlying strata is 500 to 650 feet thick. To support this mass, pillars no more than eight and ten feet thick are left, while the room-workings are made from twenty-four to twenty-six feet wide. No value is placed on this pillar coal, the main concern with all the companies being to get out coal as cheaply as possible in working forward, without regard to ultimate consequences.

The dip of the Coal Measures is quite marked in the mines of the Bellaire district. It is south 82 degrees east, and exceeds 40 feet to the mile. Rooms can only be turned from one side of the butt entries, by reason of the dip.

The Pipe Creek mines are opened at the foot of one of the highest hills in Belmont county. I spent several hours on the mountain side, noting the number and thickness of coal beds above the Pipe Creek mine, opened on the Pittsburgh coal, and found a bed of coal from three to four feet thick, sixty-three feet above the Pittsburgh seam, resting on a floor of limestone. This is a local bed, and the coal is very impure, having two layers of slate running through it. The lower stratum, three inches thick, was composed of fire-clay; the upper stratum was two inches thick, and was black shale. The immediate cover of the coal was a stratum of iron ore, but both the coal and ore appeared to be very irregularly deposited. Fifteen feet above this coal there is a four-feet seam, in a homogeneous mass, and of good quality. The horizon of this coal is well marked at Bellaire, where it is exposed to full view on the bluffs fronting the river. One hundred and twenty-five feet above this four-feet coal there is a good block coal, three feet in thickness. This is also a pure and homogeneous seam, entirely free from slate; it appeared to be a coal of superior excellence. Ninety feet above the three-feet coal there is another block coal, four feet thick, the upper two feet of which is a splint coal, and burns into a white shale, but the lower two feet are of admirable quality. This makes four workable beds of coal above the Pittsburgh seam, besides a number of small seams, two of which, as seen in the passage-way of the slope, measured about a foot each.

The following is the material as seen, and thickness of same, beginning with the Pittsburgh coal in bottom of mine:

Coal	5½	feet.
Shale, sandstone, and limestone	63	"
Coal	4	"
Rock and slate	15	"
Coal	4	"
Limestone and rock	150	"
Block coal	3	"
Slate and rock	93	"
Coal, top part splint	4	"
To top of hill (material not examined)	200	"

THE POMEROY REGION.

All the mines of the Bellaire region on the Ohio River, below the Pittsburgh Works, as already stated, are opened below the level of the bed of the river. This seam of coal never reappears above water again until we reach Minersville, in Meigs county.

The first opening in the Pittsburgh seam in the Pomeroy region, in descending the river, is the Antiquity shaft, near the village of Racine, in Meigs county. The shaft has not been visited because, since the passage of the mining law, it works less than ten men at once, and consequently does not come under the requirements of the law. It has but one opening, and is two hundred feet deep. The owners have assured me that a second opening will be provided before more than ten men are allowed to work in the shaft. The two mines at the village of Syracuse, one a shaft and the other a slope, have double outlets. The shaft has covers on the cages, and safety-gates on top, also safety-catches. The ventilation has been improved by the erection of a large and substantial furnace, erected since my first visit to the mines.

I received complaints during the summer of bad air prevailing in the Pamunky mine, but on visiting the district shortly afterward, the mine was idle and was not examined. I called the attention of the superintendent of the Pomeroy Coal Company to the facts, who promised to see that all cause of complaint would be removed. This mine, although owned by the Pomeroy Coal Company, was leased out, the lessees agreeing to work the mine according to the requirements of the mining law·

In my last report I alluded to the system, long in practice, of driving double entries in the mines of the Pomeroy district. Since the law went into effect, the underground manager of the Pomeroy Coal Company's mines has suggested an improvement in the plan of ventilation. The ordinary practice was to carry the air forward along one butt-entry, and return it by the other, allowing it to diffuse through the room-workings by break-throughs or cross-cuts, made from one room to another after the rooms had been advanced forty yards. The proposed improvement is to take the air off the entries as soon as cross-cuts are made from one room to another, and carry it along these cross-cuts. By this arrangement the moving current of air will be forty yards nearer the working faces in the last stages of work. As the rooms are driven up eighty yards, and but one break-through is made on the way, there is often defective ventilation, particularly in the rooms opened on the return, where the miners get the air loaded with all the impurities collected in its passage from the first workings.

The general superintendent of these mines, Mr. Horton, desires to see all improvements applied for the safety and comfort of the miners. The system of driving too entries along side of each other, to improve the ventilation, was first applied at Pomeroy by Mr. Heckard, the resident mining engineer of the mines, before it was thought of in any other region of the State.

The Pomeroy Coal Company, at their six mines, employ nearly seven hundred men and boys, when the mines are in full running order. This force is divided up as follows:

Miners cutting coal	506
Miners, roadmen, drivers, etc.	120
Outside hands	55
Total	681

At the present time this force is not employed, and one of the mines has been idle altogether for nearly two years. During the summer months, when the river is too low to ship coal, and during the winter months, when it is frozen up, the mines are laid idle altogether. The miners do not average more than seven months' work out of the twelve, but when they are working they generally make good use of their time.

THE IRONTON REGION.

The mines of this district are found in Lawrence county, and are opened on the lower Coal Measures, in Nos. 6 and 7 of the geological nomenclature. The Bellford mines of Norton Bros. & Co., two in number, were visited and inspected during the month of July. They are both drift openings. The coal is from three and a half to four feet thick, and is doubtless the equivalent of No. 6. Double outlets are provided, and furnace ventilaton applied. The air was not as good in many of the places as it should have been, and the old, rude, bad practice of working forward by single entries prevails. While, under this plan, it may be possible, with ceaseless vigilance and a vigorous current of air, to keep the entries and forward rooms in a fit state for men to work, that ceaseless vigilance and vigorous current are never provided. And all over the State, where single-entry work prevails, there has heretofore been bad air in the entries, and bad air in the head-rooms; oftentimes so bad that no man could work longer than five and six hours a day. This system of working by single entry, and with a feeble ventilating current, almost invariably go hand-in-hand.

The Lawrence mines of the Lawrence Iron Works were also inspected. The ventilation was provided by the natural forces, and it was better in this mine, but at the face of the entry-workings was defective. The coal of this mine is the equivalent of the Bellford mines, and is of the same quality and thickness. Another mine of this district was visited, but as it was idle at the date of visit it was not examined. There are two or three other mines besides those named in operation in this vicinity, which have not yet been visited. All these works are drift openings, and have double means of exit and entrance. The ventilation is the only requirement of the law which needs improvement; but in drift-mines, as in slopes and shafts, it is the most important one. Drift mines are worse ventilated, as a rule, than shafts.

THE JACKSON REGION.

These mines are all shaft openings, sunk on the lower coal of the series, the equivalent of the Mahoning Valley coal. None of the mines exceed one hundred feet in depth, and they are all provided with several means of exit, and with ladders in one of the shafts for the egress of the miners. The coal is used in the blast furnaces of the district as it comes out of the mines, there being usually a blast furnace alongside of the coal shaft. Usually not more than twenty-five or thirty men work in any one of the mines in the neighborhood of Jacksonville—just force enough to run a furnace.

At Wellston, eleven miles north of Jackson, on the Portsmouth branch of the Marietta and Cincinnati Railroad, two shafts are in active operation, one of them having been sunk since the law went into force. The shaft of the Milton Furnace and Coal Company has now a second outlet provided. It is a shaft in which a good and substantial stairway has been placed, and the miners can descend and ascend at pleasure. The mines of this district are generally safe. As they employ but a small force of men there can be no excuse for bad air in any of them, the means of ventilation being of easy command.

In the mines at Jackson Court-house the coal lies on the ground in hollows and arches, forming a series of synclinal and anticlinal curves. At Wellston it is evenly and regularly bedded. Both coals serve nearly equally well in the blast furnace in a raw state, and because of this quality they have been considered as equivalent seams. I regard the Wellston coal as an upper seam, separated from the place of the Jackson bed by one hundred to one hundred and forty feet of strata. The Wellston coal does not exist at Jackson, because there is not the height of land to embrace it, and the Jackson coal may not exist at Wellston, for it is a very irregularly deposited bed, and is often wanting where it is due.

This region was visited twice during the year, but only the Wellston mines and the Huron mines were inspected.

THE VINTON COUNTY REGION

Includes all the mines in operation along the line of the Marietta and Cincinnati Railroad, between Hamden and the Carbondale mines of Athens county. All the openings are in Nos. 3, 5, and 6 of Dr. Newberry's enumeration. The Vinton Coal and Iron Company's shaft, one hundred and seventy feet of perpendicular depth, is opened on No. 3, the equivalent of the Wellston coal. The coal possesses the open-burning properties of the Jackson county coal, and is fitted for furnace use in a raw state. At the date of visit to this district this mine was idle, and was not inspected.

The two mines of the Zaleski Company are opened on Nos. 5 and 6. Both seams resemble each other in height, and in the presence of two layers of slate which run through the coal, but they are independent seams, and are separated from each other by about seventy feet of strata.

The lower coal, opened near the village of Zaleski, splits in two within a foot of the roof, and the separated parts continue to diverge along the east entry until the wedge of slate which divides them has increased in thickness to twelve feet, forming two seams.

Both mines of this company are drift openings, and neither of them were very well ventilated. The mine of the lower coal made black-damp more abundantly than any other mine I have yet examined in the State. There was quite a vigorous current of air moving along the air-gallery, and it was brought forward within a few yards of the inmost room, yet so abundant was the black-damp that the light could only be maintained by moving slowly, and holding the lamp downward. In such an atmosphere a miner had been working during the fore part of the day. I directed the boss to find him another place, and stop the room until fresh air could be brought forward to renew the circulation. Double outlets were provided at both mines.

The Buckeye mines of the Ingham Coal Company, at King's Switch, situate in Athens county, are opened in No. 6, and were found in good order. The openings are level-free.

The works of the Carbondale Coal Company are also in Athens county. They are drift openings, and were in fair condition. The coal is also No. 6. These mines were opened many years ago, and were made the subject of two experiments, still unknown in successful practice in this State, that of excavating the coal by a coal-cutting machine, and opening and working the mines by the long-wall system. Both experiments proved failures, so far as reducing the price of mining was concerned, which was the object sought to be accomplished. The seam of coal is well adapted to long-wall work, but the pack-walls, instead of being of mine refuse, were made of hewn timber of more value than the coal pillars needed for supporting the mine, and the coal-cutting machine required more hands to operate it in cutting a ton of coal than would be required by manual labor. The successful application of coal-cutting machines in mines is, however, only a question of time. The miners may look with disfavor on their introduction, but they will come as their best friend, for they will take much of the exhausting manual labor off the shoulders of the miner.

These mines are now in a fair state of ventilation, and work a large force of men. The coal is thinner than it is in the mines of the Hocking Valley opened on the same bed.

THE HOCKING VALLEY

Includes all the mines operated along the Hocking River between Athens and Logan. The mines are all level-free, except three shafts at the lower end of the district, two of which work less than ten men. The mines are operated on No. 6. Those furthest up the valley, as Brooks's, Laurel Hill, Lick Run, and Hayden's mines, operated near the out-crop of the coal seam, have abundant means of ingress and egress among the numerous ravines which cut down through the coal. The system of opening up the mines is by single entry, and reliance is had for air by driving the entries through the hill, and trusting to the natural forces for the necessary current of air. Where the surface conditions forbid getting a second outlet through the hill, an air-course is driven along the face of the coal from one butt-entry to another, to cause a circulation. An effort is made to keep the miners working in rooms on a range of work swept by a current of air, and to have the air entry drivers alone working in the part beyond the reach of the current. By this arrangement the men in the rooms have generally, but not universally, a fair supply of air. The workmen in the entries, however far advanced in the fast, have not and can not have good air.

As the roof of the coal of these mines is generally hard and firm, and the superincumbent strata quite light, the rooms are worked twenty-four to forty feet wide, and the pillars are only eight and ten feet thick. After the rooms are worked this pillar of coal is left standing, and is lost. If double entries were driven on the face and butts alike, with strong pillars between each entry, to be pierced only for air, and the room pillars made strong enough to break a crush of the strata in working backwards, 95 per cent. of this coal might be recovered, and better ventilation would prevail. A ventilation relying on the natural forces alone is subject to the season, as a ship is subject to the wind. Artificial ventilation by the furnace or fan, when all the necessary arrangements are complete, is like a steamship, and can defy the wind or season. The true miner never complains of the season, but defies and controls it.

The mines at Lick Run were in a bad state in regard to ventilation. There are two main openings, one of which had no return for air, and the miners were suffering. The face of the entry, however, at the time of inspection, was nearly forward to a cross-air course driven from the other mine, and when this was reached the desired result could be attained. The other mine had an up-cast shaft, constructed of wood, near the mouth of the main entrance. In this shaft an iron fire-lamp or basket was kept burning during the day, and gave a little motion to the air, but some of the room-workings were unfit for the abode of the miners. I urged the mine-owner, Mr. Scott, of Nelsonville, to drive double entries, and to sink an air-shaft at the back of the workings, establish a furnace at the bottom, and carry an abundant supply of air through the mine.

The existing arrangements would suffice until these improvements are provided.

Poston's mines and those of the Nelsonville Mining Company are holed through in each other, and one serves for receiving and the other for discharging the ventilating current of air. The entries are all single, but air-courses are driven on the face of the coal from one entry to another, where there is no opportunity of getting out to day-light. The arrangements for ventilation were good in both of these mines.

The Nelsonville Mining Company, as observed in my last annual report, is a sort of co-operative concern, and, so far, may be said to have proved a success. Many of the original owners of shares have sold out, but new men have been found to buy their interests, and the mine has run steadily and had a good share of the coal trade since the first shipments were made, nearly a year and a half ago.

In Longstreth's mines, situated one mile below the village of Nelsonville, the cover of the coal is thicker than at Hayden's and Brooks's, and there are not as many chances to get out to day with an entry. The mines, two in number, both in communication with each other, are laid out in a series of blocks. The butt-entries are single, and are four hundred and fifty feet apart. The air-entries, driven from one butt-entry to another, are also made about four hundred and fifty feet apart, ten rooms being contained in each block. In these mines the pillars are recovered as the workings progress forward. After the rooms of a block are finished, the pillars are attacked. The entrances to the mines are made very narrow, to add strength to the entry and to break the crush which follows the removal of the pillars. But with this precaution the entries are not strong enough, and last summer a crush of the strata, which followed the extraction of the pillars, threatened to overrun and close it, and was only prevented from making a total wreck of a valuable and extensive portion of the mine by building a number of shanties (pillars of wood) and by timbering the entry at great expense. If the entries of this mine had been double, with a strong pillar between them, the crush would have been powerless for harm. Moreover, very little, if any, saving is made by single entries, as the money has to be expended on the air-courses, driven from one butt entry to another every four hundred and fifty feet, in dividing the mine into blocks, while the air-course drivers have never good air. The superintendent of these mines is one of few in the Hocking Valley who makes any attempt at the recovery of the pillars of the mine. Coal lands are cheap and abundant, and thousands upon thousands of tons of coal are annually lost to posterity, beyond the possible hope of recovery, in abandoned and crushed pillars.

Two miners were killed in one week in Longstreth's mines during the summer. An examination into the cause of the accident, made by request of the miners, did not seem to attach any blame to the mine-owners or to the officers in charge of the mines. The unfortunate men met death in their working places under circumstances beyond the control of the officers of the mines. Just at this time, however, the miners were very much excited, as the crush of one of the entries, referred to above, was then in progress. The falling masses of rocky strata, the squeezing of the entry-pillars, and the creeping of the coal floor, excites the fears of miners, even though their judgment teaches them that there is no cause to fear sudden and immediate danger. A few of the miners, unused to such scenes, seemed to think that the whole mine was about to close.

The mines at Doanville, the property of the New York and Ohio Coal Company, were ventilated by the use of a furnace. It was too small for good results. The miners complained of bad air, and an examination of the mine showed that a number of miners were at work beyond the reach of the circulating current of air. The mine superintendent promised to sink an air-shaft at the back end of the workings, and place a large and substantial ventilating furnace at the bottom of it. I suggested the advantage of driving double parallel entries and carrying the ventilating current along as the workings advanced, instead of the ordinary plan of driving air-courses in the fast, in which men are forever plunged in a stagnant and foul atmosphere. The old primitive mode adopted in the early days of mining, when the subterranean excavations were of limited extent, must disappear before the requirements of the mining law.

The Floodwood mines have several outlets and an air-shaft, and the working places of the miners were above complaint. The ventilation is by natural causes. The coal of these mines, usually five feet nine or ten inches high in the workings, is seven or seven and a half feet at a few points of the mine. This additional height is caused by the union of two coals—by an upper coal, a foot or so thick, coming down and uniting with the main seam. This upper stratum exists at all the mines of the valley, but it is separated from the main seam by a wedge of slate from four to nine feet thick. At the Doanville mines the slate was thinned out to nothing, and the two coals form one seam, making nine feet of coal all over the mine. Northward, towards Straitsville, Shawnee, and Buckingham, the upper coal has increased in thickness to four and five feet, and, remaining united with the main seam, forms the great eleven and twelve-feet vein of Perry county.

STRAITSVILLE AND SHAWNEE DISTRICTS.

The mines of this region are mainly located in Perry county. They are all above the base of the hills. The coal is from eight to eleven feet

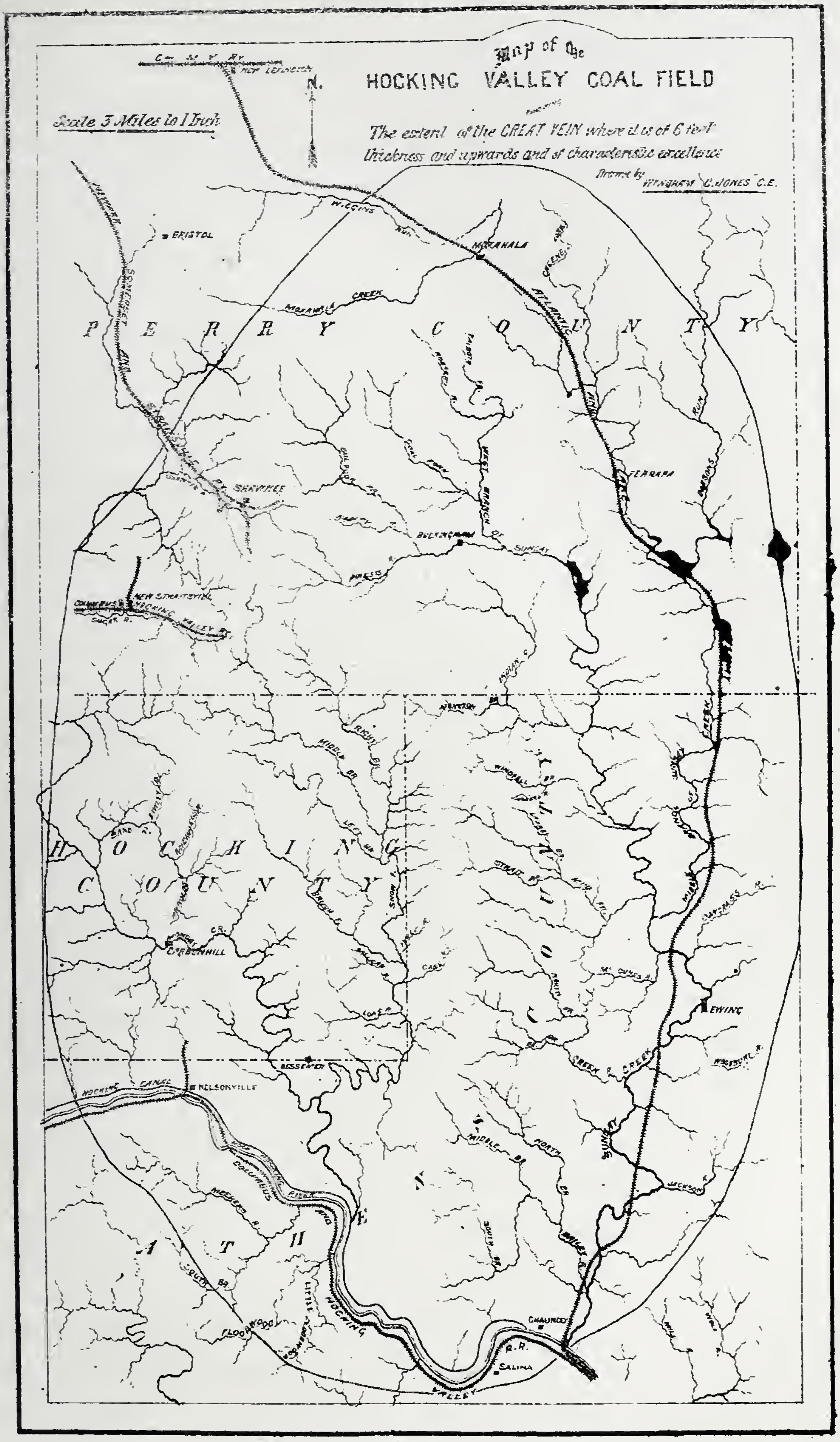


PHOTO.LITH.W.J.MORGAN & CO. CLEVELAND, O.

high. Both of these districts have been opened up within the past five years, and the mining developments have been wonderful. Some of the mines are worked on more approved systems than prevail along the Hocking valley, all the entries being double. The pillar coal can be recovered in mining forward, and furnace ventilation is applied. In some of the mines opened up on the old plan crushes have already occurred, and crushes will yet occur in others, and there will be a fourfold expenditure required to save these mines from total wreck. This would have sufficed to cut double entries and to have left pillars of the requisite thickness and strength. A thick seam of coal, with all other conditions equal, requires stronger pillars than a thin seam to support the superincumbent strata, just as a long prop will break and give way in supporting the roof, where a short one of the same diameter would stand firm.

The mines of the Newark Coal Company, at Shawnee, three in number, are all worked by driving double entries, and have furnace ventilation. The three mines are all connected with each other, and a good state of ventilation prevails. The Lyonsdale mines are also opened in this manner, and have furnace power to cause a movement of air. The Troy mines, at Straitsville, originally worked on the plan of driving one entry and opening rooms from both sides, have changed to cutting two entries. This mine has a good furnace, and at the date of inspection was in a praiseworthy condition, so far as ventilation was concerned. The Plummer Hill mine is opened on the butts of the coal by driving a single entry through the hill. The ventilation is by the natural forces, and sweeps through the mine along the entry where the people are employed. Some of the miners complained to me, that owing to an indiscriminate system of blasting at all hours of the day they were annoyed by the powder smoke. I called the attention of the mining boss to this fact, and he forthwith forbade the use of powder in the mine till four o'clock in the afternoon, and henceforth the mine was kept free from powder smoke and the air kept clean and sweet. Where there is no occasion to blast more than once in a day—and there are few districts in the State where more than one shot is needed—discharges of gunpowder at all hours of the day will pollute the air of a mine ventilated by a single current, no matter how vigorous the current may be. The workmen who get the first of the air are not annoyed, but the powder smoke has to pass the working places of one hundred or one hundred and fifty men beyond, and before the mine is cleared of the products of one blast, another blast occurs, and all the people in the return current are plunged, from morning till night, in an ever-thickening atmosphere.

The old mine of the Straitsville Mining Company is ventilated by the natural forces. On the first visit to the district this mine was idle, but on a subsequent visit it was running to its full capacity, and was inspected. It has several outlets and two or three air-shafts, and the ventilation was good.

The mines of the Central Mining Company, two in number, are holed through in each other, and also to the mines of the Mining Company. There is an air-shaft also. Ventilation was promoted by means of the vent from a steam-pump at the bottom of the air-shaft. One of the entries was driven in the direction of a ravine, and was meant as a permanent air-way.

The Muskingum valley region extends along the line of the Shawnee branch of the Baltimore and Ohio Railroad, between Shawnee and New Lexington; thence along the Muskingum Valley and Cincinnati Railroad to Zanesville; thence down the Muskingum River to Marietta. There are a large number of mines, the greater number of which are opened in No. 6, which, from a gigantic seam of ten and eleven feet in height, at Straitsville and Shawnee, dwindles down to two and a half and three feet in many of the mines of this region. All over this vast area, however, the coal retains certain characteristics—dry and open-burning, and a superior coal for generating steam, for rolling-mill purposes, and doubtless fitted for blast-furnace use in a raw state. Wherever opened, it is also found in three layers or benches, and with two thin layers of fire-clay and shale running through the seam. The upper bench of coal is, however, very thin and impure at a number of points, and is not mined.

Along the Muskingum Valley Railroad, and also along the Muskingum River, the coal is a "block coal," which, after it is undermined, can be brought down without the use of either powder or wedges. The only tools required by the miner are a set of picks and a shovel.

No great force of men work in any of the mines, and the coal is brought from the wall-faces to the outside, not by horses and mules, as in other mining districts, but by the miners themselves, assisted by dogs. The dogs are harnessed up like horses, and pull at the front of the loaded car, the miner pushing behind. One miner sometimes owns as many as three dogs, all of which are harnessed up together in single file. All the mines, except one shaft at Zanesville, fifty feet deep, are level-free, the working force ranging from three to twenty men in each mine.

At New Lexington two seams are mined, Nos. 5 and 6. The same seams are opened at Delcarbo and at Zanesville. The Muskingum River flows along the dip of the coal measures, and the bluffs fronting the river afford a fine field for the geologist. Nos. 5 and 6, which are high up in the bluffs at Zanesville, dip under water before reaching Blue Rock, the coal of these latter mines being No. 7. This seam soon gets under water also. Then comes a long stretch of the barren measures, until No. 8, the equivalent of the Pittsburgh bed, begins to cap the top of the hills. Twelve miles above Marietta, No. 8 also plunges under the river. Above this bed no other seam of the upper coal measures has been opened, and it is possible that none of them exist. The strata in the hills at Marietta resemble the red shales of the barren measures, though they undoubtedly belong to a horizon above the Pittsburgh coal, which lies buried under the waters of the Ohio at least one hundred and sixty feet deep.

All the mines of this region have proper means of exit, passages being cut through the coal in the mine to ravines on the flanks of the mine. The ventilation is left to the unassisted forces of nature, and is often defective for want of driving the necessary air-ways to properly distribute the air. The art of ventilation is not understood. There are sixty or seventy of these small mines in operation in this region, most of which work less than ten men at once, and so do not come under the inspection law.

Coal No. 8 on the Pittsburgh bed is opened and worked at Coal Run. The seam is from three to four feet in height, and has an upper bench, the two coals being separated by a band of fire-clay. This mine was in a dangerous condition at its entrance. The timbers were too weak, and many of them were cracked or broken, and liable at any moment to fall in two. I urged the mine-owner to repair the work at once, which he promised to do, and which he had of his own accord already contemplated.

THE CAMBRIDGE AND DUCK CREEK DISTRICTS.

Along the line of the Baltimore and Ohio Railroad, near Cambridge, in Guernsey county, a number of mines are opened on No. 6 or 7. The coal is fully five feet in height, has a fine roof, but a soft and yielding fire-clay bottom. There is one coal shaft in the district. It is less than forty feet of perpendicular depth; all the other mines are level-free. The older openings of the district were made with wide rooms and small pillars, and have been overrun with creeps—the pillars sinking into the floor and closing up the excavations. More approved systems now prevail, and furnace ventilation is provided. A section of the mines of the Scott Coal and Salt Works has been opened up by driving the rooms on the butts of the coal, an experiment which the manager hopes will lessen the cost of mining, and add to the security of the mine.

Approaching the village of Cambridge from the east, along the line of the railroad, the coal appears to be troubled with "horse-backs," and to be latterly supplanted by a bed of sand-rock, which usurps the place of the coal, leaving no trace of its existence.

Double outlets are provided to all the mines, and the ventilation has been greatly improved in the district, though improvement is still needed.

The Macksburg mines are located along the line of the Duck Creek Railroad, between Marietta and Cambridge, in Washington and Noble counties. The coal is five and one-half to six feet in height; then there are two and one-half to three feet of fire-clay overhead, and above this another seam of coal of varying thickness, but averaging about three feet. This is the Pittsburgh coal, or No. 8, and it here retains its usual purity and excellence. The mines are level-free, and are opened by driving the main entries forward along the face of the coal. The mines are made twenty-one feet wide, and the pillars eleven feet thick. All the openings are provided with double means of ingress and egress, and the ventilation, as far as examinations were made, was fair, though all the mines were not inspected, as they were idle at the date of visit, April 27.

The coal at the Dexter mines is 190 feet above the level of the railroad, and the mines are twenty-six miles from Marietta. About midway between the mines and the Ohio River, along the line of the railroad, the coal dips under water, and at this point has thinned down to three and three and one-half feet.

A number of oil wells have been sunk in the neighborhood of the mines, and some of them were yielding paying quantities of oil. The wells range in depth from 160 to 600 feet. The oil is found in the coal measures, and is struck in a dark sandstone. Ten wells are located on Goose Run.

THE SALINEVILLE DISTRICT.

These mines are in Columbiana county, are all drift openings, and are opened in No. 6 and 7. No. 6 is from three to seven feet high, has a fine roof, and the workings are high and dry. No. 7, a three-feet seam, is higher up in the measures, being separated from No. 6 by strata ranging from thirty-three to seventy feet in thickness. The roof is also good, and the working places dry. These mines, taken in their aggregate and in their parts, are among the worst ventilated in the State. Powder is used in every working place to get down the coal, and the miners fire at all hours of the day. The powder smoke hangs in blinding and suffocating volumes. Until recently the forces of nature alone created the air-currents, and they generally came and went without control, as no proper air-courses nor air-doors and stoppings were provided to direct forward and distribute the slow-moving stream. Some of the mines are yet without sufficient artificial means of forcing forward air, and also without the necessary air-ways. In all of them the current of air is not as strong as the law requires, nor are the air-passages and doors as numerous and as promptly provided as they should be. All the mines are opened on one plan, though some of them are in much better order than others. To have good air double entries—main and butt alike—must be made, and all the stoppings closed up as fast as new air-channels are cut through at the heads of the entries and rooms. I have had several complaints of bad air in the mines of this region, all of them too well founded, and, unless improvement is made in the ventilation, will be obliged to apply to court to enjoin or restrain their working with more than ten men at once until they are made to comply with the requirements of the law. Much suffering and cause of complaint could be avoided by prohibiting the miners from blasting more than once per day—at four o'clock in the afternoon, as is done in many other districts; but even were no blasting done at all, the ventilation is too feeble, and the air channels too few and far between for the sanitary requirements of the mine.

WASHINGTONVILLE AND NEW LISBON DISTRICTS.

Around the villages of Washingtonville and Leetonia, along the line of the Niles and New Lisbon Railroad, the mines are opened on two thin but valuable beds of coal, Nos. 4 and 5. They are about forty feet apart. The upper coal is the more highly prized, although the thinner bed. Only in two cases has the lower coal been tapped—at the shafts of the Salem Coal and Iron Company, and the Grafton Coal and Iron Company—in both of which shafts the two seams are raised together. The upper coal is only twenty-eight inches thick, but it is all pure, and is all sent out, slack and run of mine together, and converted into coke at the pit's mouth. The entries of the mines are made of sufficient height by blasting down the roof shale to admit of handling mules, but the rooms are only the height of the seam. In these low chambers several hundred men earn their daily bread. The rooms are carried forward fifty yards, and are then finished up, new openings being made in advance galleries. The mines of the Cherry Valley Iron Company, three in number, one slope and two drifts, were in good condition, except in a few cases at the entry-faces, where the air-ways had been neglected. Proper means of exit were found, and at the slope-mouth an approved safety-spring was attached to prevent the cars from running down the slope in case of accident. This is the only spring I have seen in the State which could be applied to advantage, and as filling the requirements of the law, and its application ought to become general.

The mines of the Grafton Iron Company were running only six or eight men, at the date of visit, on the lower coal. They were engaged cutting an entry forward to the boundary of an entry in the upper coal, which had dipped and was submerged by a recent inflow of water.

The mines of New Lisbon were idle, and were not visited. They are drift openings. The coal is No. 6, and is of varying height, usually about four feet.

The miners of Washingtonville are among the most intelligent and progressive of their class in the United States. They have built a mining institute, in which they meet regularly for mutual improvement. In the evenings the institute is used for a night-school, at which the boys and young men of the mines attend. On Saturdays the older people meet to discuss questions of government and matters of interest bearing on the amelioration of the working men. On Sundays the institute is converted into a church, the preacher, in most cases, being one of the miners themselves. A number of the miner-boys have used the savings of previous earnings to educate themselves, and are now about to enter the learned professions. During the vacations of school these lads returned to the mines and worked their way up by their own energy and perseverance and frugal habits. The future of such young men is already known. They will yet command the attention of states and nations. Of just such material are the great men of every age and nation.

In the construction and management of this institute the miners have had the countenance and assistance of the company and its officers. The company gave the lot on which the building stands, and the superintendent of the mines gave sixty dollars and advanced the money to erect the building, the miners paying him back with interest on the money borrowed.

If other coal companies would take equal interest in the moral improvement of miners, there would soon grow up a healthier sentiment between the laborer and his employer, and strikes and lockouts would be fewer. And if, after the hard and exhausting toils of the day, the men of the mines had some place to meet, where books and newspapers could be had, there would soon be fewer saloons in the mining villages of the State.

The coal of the mines of Washingtonville and Leetonia, although only two feet four inches high, costs, in some cases, only sixty-eight cents a ton for digging and loading, while the ten-feet coal of Perry county costs sixty cents a ton. At Leetonia all the coal is sent out as it comes from the workmen's picks, and no powder is used to get it down. In the thick seam of Straitsville and Shawnee two layers of slate are interstratified with the bed, to clean which it costs the miner much time and trouble, and in addition about one-fifth of the coal which the miner hews at these thick seams is made into slack and nut coal, for which nothing is paid. In coal-mining the quality of the mineral is of more importance than the height of seam. The miner's ability to produce a given quantity of tons per day is not always in proportion to the height of seam.

THE MAHONING VALLEY.

This region, the most extensively developed in the State, was the first inspected after my appointment to office, in April of 1874. The law gave stated times for certain of its provisions to be applied. I went from one mine to another, examining all their underground workings, machinery, etc., and notified every company by printed circular of the requirements of the law, and that the provisions of the act must be complied with. These circulars were also sent to all other operators in the different regions of the State, as far as known at the time. After having traversed the various mining districts and made examinations of the great majority of the mines, many of them two and three times, I re-commenced work in the Mahoning Valley, and found that while there was generally more care and attention given to the ventilation, and in most cases safety-catches and covers for cages had been provided, the speaking-tubes had been neglected. One of the mines, the Sodom slope, in Trumbull county, had had an inch speaking-tube applied, but as the slope was nearly five hundred feet in length, the tube failed to convey sound so great a distance, and was withdrawn. On being notified of these facts, I wrote to one of the Pennsylvania inspectors regarding the size of tubes in use in the anthracite regions of that State, who informed me that it required in practice a two inch or two and a fourth inch tube to convey sound five hundred feet so that conversation might be held at both ends of the pipe. I notified a number of the companies of the size of tubes required, and urged them to apply them as the law directed. Each superintendent said he was waiting on some one else leading off, and so none of the slopes of the valley provided them.

Finding defective ventilation prevailing in the advance places of a number of mines, and that the law would be disregarded in other particulars unless the penalty attached for violating its provisions were visited, I asked the opinion of the Attorney-General in regard to employing an attorney to prosecute proceedings in injunction, and also as to my duty in case of willful and persistent neglect on the part of a coal company to obey the law. The following is the answer of the Attorney-General:

"COLUMBUS, March 23, 1875.

"HON. ANDREW ROY, *Mine Inspector, Columbus, Ohio:*

"SIR: In answer to yours of the 21st instant, I have to say—

"1. If it becomes necessary in the discharge of his duty to have an attorney to prosecute proceedings in injunction under the 14th section of the act regulating mines and mining (Laws, 1874, page 24), the mine inspector may employ and out of his contingent fund pay such attorney.

"2. Said act, by implication at least, makes it the duty of the mine inspector to see that the provisions of this act are obeyed. If to compel obedience to the requirements of sections 9 and 10 (or of any other) it is necessary to resort to the remedy by injunction, he, in my opinion, should not hesitate to do so.

"Very respectfully,
"JOHN LITTLE, *Attorney-General.*"

During the spring and summer I repeatedly urged upon the mine superintendents of this valley that the tubes must be put in, but finding no disposition manifested to comply with the law, I employed Messrs. Taylor and Jones, attorneys-at-law, Warren, Trumbull county, to prosecute the Niles Coal Company, under section 9, and the Church Hill Coal Company, under sections 9 and 10, the former company for having defective ventilation, and the latter for defective ventilation and neglect or refusal to apply a speaking-tube in the slope. At the same time I employed Messrs. Foran and Hassack, of Cleveland, to prosecute the Mahoning Coal Company, under sections 8, 9, and 10, the mine having but one proper means of egress, having also defective ventilation, and being without a speaking-tube. In this latter case the court, in accordance with the petition, granted a temporary injunction, but it was at once dissolved by mutual consent, and the case set for trial in November following. It has not yet been reached. The cases against the Niles Coal Company and the Church Hill Coal Company have also not yet been reached. I have recently received a communication from the Niles Coal Company, stating that the ventilation had been improved, and requesting the discontinuance of legal proceedings. I shall make an examination of the mine before the case comes up in court, and if the law is now being complied with, will withdraw the suit.

The excuse made by the Church Hill Coal Company for failure to provide the speaking-tube is that this part of the law is useless, and consequently oppressive. The superintendent thinks that tubes are proper and necessary in shafts, where the human voice can not be understood, but in slopes, through which the miners can travel at will, there is no necessity for having them. Their necessity is greater in shafts than in slopes, but their necessity in slopes is none the less on that account. These slopes, and in particular the slope of the Church Hill Coal Company, is a dangerous passage-way from the bottom to the top, and no miner ever makes the journey through it without experiencing some degree of fear. The miner from below has occasion to call on top for props to protect his working place. Some one must ascend for them, and ascend behind the loaded train. There is no room for travel on either side of the slope, and as the empty train goes plunging past, the traveler must seek refuge by climbing over the pitments and discharge-pipes of the pump. A man may also get seriously hurt in the mine. In those cases of danger moments are precious; communication can be made in a moment through the speaking-tube; without it some one must climb five hundred feet of a slope on a grade of forty degrees. The chain may break, or the empty train may be pushed over the brow of the slope by accident. The alarm, under such circumstances, can be sent below with telegraphic speed by the "call" on the tube. Without the tube the lives of the people at the bottom are imperiled, and not a few fatal accidents have been caused by this means. In some slopes the occurrence of fire in the wooden structures near the mouth of the slope might imperil the safety of the whole underground population, and a fire occurring in the slope might do the same thing. Indeed, the accident at the Atwater slope, which occurred in July, 1872, by which ten out of twenty-one miners were lost, was caused by the slope timbers taking fire. A boy on top, observing the fire, ran down through the burning timbers to alarm the miners, and perished on the way out.

Mr. T. M. Williams, inspector of mines for the Wilkesbarre (Pennsylvania) district, to whom I wrote for information in regard to the size of tube in use in Pennsylvania, replied as follows:

For a length of	200	feet, we use	1½-inch	diameter.
"	300	"	1¾-inch	"
"	400	"	2-inch	"
"	500	"	2¼-inch	"
"	600	"	2½-inch	"

Our operators, adds Mr. Williams, are using galvanized gas-pipe—galvanized outside as well as inside. Some use nothing but common gas-pipe, and as a matter of course such pipes require to be of larger diameter because of the roughness of surface.

The Kyle shaft of Mahoning county, on my first visit to the mine last year, was without covers for the cages or safety-gates over the entrance of the shaft. The mine made fire-damp, and every man was his own fire-viewer. On my second visit I found a great change for the better; not only were the cages covered and safety-gates applied, but the ventilation had been greatly improved. All the doors for guarding and directing the currents of air in the mine had been so hung and adjusted that they shut of their own accord and can not stand open, and they were unusually well constructed and hung. A large and powerful ventilating furnace had been erected, moving 20,000 cubic feet of air per minute, and an experienced fire-viewer appointed, who examines the mine every morning before any of the miners are allowed to enter.

The following regulations I found in the engine-house of this mine, and commend them, or something similar, to the notice of other mine superintendents in the State:

RULES AND REGULATIONS OF KYLE SHAFT.

1. No man shall be allowed to descend who is intoxicated.
2. No more than ten men shall be allowed to ascend or descend on any one cage.
3. No man or men shall be allowed to descend with the mules, except the man in charge.
4. Drivers and mules shall first descend the shaft in the morning, in order to prepare for work.
5. The hitcher-on shall have full control of the shaft during working hours.
6. Not less than three men shall be allowed to ascend during working hours, except entry-men, or in case of a sickness dispatch from top.
7. No person shall interfere with the signal wire while the holder-on is on duty.
8. Any person who shall commit a nuisance in the air-ways or gang-ways, or destroy, brattish, or leave doors open, shall be reported to the State Mine Inspector.
9. These rules and regulations must be strictly observed.

D. B. STAMBAUGH, *Superintendent.*
JONATHAN OATEY, *Pit Boss.*

In a number of mines of this region many advance places are badly aired, because they are pushed ahead in the fast, and a circulation is only got up after rooms are broken off the entry and communication made from one to another by cross-cuts in the pillars. From six to twelve men are thus working ahead of the air in a stagnant atmosphere. In the first few hours of work, the working places are generally clear, and fit for the abode of the miners, but the atmosphere is hourly thickening with the smoke from the workmen's lamps and the exhalations from their lungs and bodies; and in the afternoon it is frequently the case that the combustion of the lights can only be maintained by hanging the lamps to a post or to the pillar side and turning them downwards. This condition of the air is rarer now than formerly, and must disappear altogether. There is no excuse whatever to have any part of a mine without an abundant supply of air, except the excuse of bad management, ignorance, or avariciousness. Safety-catches, safety-gates, and covers for the cages have also been generally applied. The safety-catch, however, should be frequently tested, say every four or six months, for its springs will lose their force by constant use and become worthless. I have been informed of a rope breaking since the law went into force where the safety-catch failed to hold the cage, although when first applied and tested it proved perfectly satisfactory.

The early part of the present year witnessed another of those long and disastrous strikes which arise over wages disputes. The mines were idle for four months, and in one instance the buildings of a colliery were destroyed by fire. The guilty parties were not discovered. Such lawlessness is discountenanced and condemned by the great mass of the miners, but it is their duty to ferret out and have the guilty parties punished.

MASSILLON REGION.

The Massillon region embraces all the mines opened on the lower coal No. 1. These mines are located in Stark county, Summit county, Wayne county, and Medina county. More powder is used in this region than any where else in the State, or perhaps in the world, in recovering the coal, at least one and one-fourth pounds being burned for every ton of coal mined. The coal is nearly all blasted out of the solid wall face. The undermining part of the seam is very hard, and the coal is better adapted than most seams for blasting out of the solid. Few of the miners blast during the working hours of the day, the prevailing rule of the region being to fire at 4 o'clock in the afternoon. In a mine working a force of one hundred and fifty men, when the discharges take place, thirty or forty kegs of powder are burned, the earth shakes with the force of the explosion, and the miners retreat in haste to the surface. For several hours after these subterranean explosions, no human being could enter the mine and live.

Most of the mines of this region are worked on the double entry system, and the advance places, the entries, and inmost rooms (which in some other districts are nearly always in a defective state for want of air) are as well ventilated as any part of the workings. All the new mines are now opened on the plan of driving the entries double, and the superintendents one and all say that no additional cost, but that, when every thing is considered, a saving is had over the plan of single entry and narrow air-courses, and no air-courses at all so long as a light can be maintained.

The Wadsworth slope of Humphrey and Colman has been visited five times within the past fifteen months, and has been twice surveyed. It is approaching the workings of an abandoned mine filled with water. Between twenty and thirty acres of coal were excavated in this old mine, when, it having been worked up to the boundary of the property, the miners withdrew their tools and the slope filled with water. This occurred before the inspection law went into force. Under the first act regulating mines and mining, passed in 1872, the operators of mines were required to keep a map of the workings, but the law was generally disregarded, and the exact locations of these old workings are not known. I have a map of the old mine, furnished by Mr. Colman, the superintendent of the Humphrey and Colman slope, which he prepared from a survey made by himself, and which is believed to be nearly accurate, as the surveying was done not long before the abandonment of the mine. There is yet several months' work to be done before the old and the new workings are holed through, but the miners are in daily dread of holing through into the old workings, and of being drowned by the inflow of water. The company have promised to keep two holes in advance of the workings, so as to tap the water and thus avoid flooding the mine.

This case suggests two amendments to the mining law, namely, that every mine-owner should be required to notify the Inspector at least four months in advance of his purpose to attack the inmost pillars with the object of finishing up the mine, and it should be the duty of the Inspector to see that an accurate map or plan of the mine is then made, covering all the excavations, and filed in his office; and further, that at the suggestion or order of the Inspector two holes should be kept at least twenty feet in advance of the workings when a mine is approaching an abandoned mine supposed to be filled with water or charged with mephitic or inflammable gases.

On my first visit to this mine I found very poor air prevailing, and a spirit of general discontent and fault-finding existing among the miners, a result invariably found where bad air existed in a mine. I urged the boss to improve the ventilation, and wrote to the owners of the mine, earnestly calling their attention to its condition. They thought the air was good, and that the complaints arose from an inherent spirit of fault-finding among a certain class of their miners. The ventilation has now been greatly improved, and if it is properly attended to will remove all cause of complaint, for, as already stated, the miners, even the most unreasonable among them, never complain of bad air when their working places are in a fit state for men to work; and this mine is no exception to the general rule. As the ventilation has been made better the miners have become more reasonable and are better satisfied. There is less grumbling and fault-finding with the mine and its management than formerly, and if the air is properly provided at all times, there will be none of it.

The Maple Grove mine, situate at North Lawrence, is another mine where a spirit of discontent and fault-finding prevails among the miners. This mine works a large force of men, and by reason of numberless horsebacks and a fragile roof the ventilation is not easily managed. Nor are the means applied for getting fresher air of first-class order. Canvas cloths, which soon become filled with holes, and spill air that is needed to supply the miners at the working faces, are used in entries instead of doors. Arrangements are almost always in progress to get purer air, yet the working faces of the mines continue to be in a defective state, and the miners grumble and complain. It is proper to state, however, that by the occurrence of one boiler explosion and two fires at the mine since the law went into operation, which laid the workings idle and disarranged the air-courses, the means of promptly applying a thorough ventilation have been wanting. These facts the miners take no note of, and it must be added that, with every disadvantage, the air might well have been better than it has been.

The wooden structures surrounding this mine have been twice burned down during the year. The first time the fire occurred it was an act of lawlessness which can admit of no excuse, and for which the severest punishment should be meted out to the guilty parties. This fire took place during the prevalence of a strike in the spring of the year. Four masked men caught and bound the night engineer of the mine, and soon afterward the engine-house was in flames.

The second fire occurred in September, and was, in my judgment, the result of an accident, though the pit boss was disposed to attribute it to incendiarism. This fire broke out in the upcast shaft, at the bottom of which the ventilating furnace stood. The fire was first seen in the wooden structure covering the top of the shaft, and could have been (as it doubtless was) communicated to this building from the furnace at the bottom of the pit. Many a fire occurs from this cause, and too great care and attention can not be given in locating a furnace in a mine.

The superintendent of the Middlebury shaft, in Summit county, as soon as the law went into force requiring two separate outlets to all mines, by which distinct means of ingress and egress shall be always available for the persons employed in the mine, cut a passage-way from the bottom of the mine to the surface, to form a safe and proper traveling-way for the miners to pass through at pleasure. There was already an air-shaft sunk, but the officers of this company put a liberal construction on the law, and made the egress of the men safe and assured, in case of accident, beyond a peradventure. This mine is also one of the best ventilated in the region, and has always maintained this reputation.

A large number of the mines, ventilated by furnace power, while having two openings—the main opening and an air-shaft—have not means, immediately available at least, for the speedy withdrawal of the men in case of fire, or the closing of the main opening from any other cause. The furnace is placed directly at the bottom of the air-shaft, and the heat, smoke, and gases evolved from the fire would forbid any attempt at exit until after the fire was put out and the side of the shaft cooled down. A fire occurring at the main opening (which is always the down-cast, where a furnace is placed at the bottom of the air-shaft) would, as soon as sufficient heat were communicated to the burning timbers over and in the shaft, to render the air specifically lighter than the air in the furnace shaft, reverse the ventilating current, and the smoke and gases from the furnace would spread through the mine and endanger the lives of the whole underground population. Such a condition may not occur in the course of a century, but it is not an improbable case. A ventilating exhaust-fan, placed on top of the up-cast shaft, would remove this danger better than even a third opening to a mine.

The ventilating furnace is the favorite power for causing a movement of air in the mines of this State. A number of mines rely upon the exhaust steam from the steam-pump at the bottom of the up-cast shaft for ventilation—always too feeble a power—and one mine has an exhaust-fan in use. For shallow mines, and mines which give off no fire-damp, the exhaust-fan is to be preferred to any other ventilating power. It costs less than a furnace, and its action is constant; besides, and most important of all, the danger of fire in the wooden structures of the shaft is avoided. I would earnestly recommend to all mine-owners opening new mines to apply a Guibal exhaust-fan instead of a furnace. Since the fatal mining catastrophe of the Avondale shaft, in the anthracite region of Pennsylvania, the exhaust-fan has come into general favor, and is every where preferred to a furnace.

Two new shafts have been sunk during the year in this district. They are both provided with all the appliances required by the mining law, and double entries have been started off in opening up the workings. The ventilation in each is provided by the exhaust steam from the pump at the bottom of the shaft, but when the workings extend, and a greater power is needed, I would urge the proprietors to use the exhaust-fan, as being cheaper, more serviceable, and freer from danger. These fans can be placed on top of the up-cast shaft, and be under the control of the hoisting engineer of the mine. By applying a fan, the air-shaft, in which it is the custom to place the ventilating furnace, can be made available at all times for the withdrawal of the miners in case of accident to the main opening, and a ladder or stairway may be put in the air-shaft, reaching from top to bottom, on which miners can pass up and down at will.

A new slope, now in progress of sinking, is being supplied with a brattice, which divides the opening into two permanent compartments—one a hoisting-way, the other a gang-way for the miners. By this arrangement the workmen can pass up and down the slope at pleasure without coming in contact with the cars. This is a much needed improvement. The slope has heretofore been more dangerous to life and limb than the shaft, by cars running over people in passing to and fro. It is a pleasure to record these improvements. The business of coal mining can be made comparatively safe and healthy, and when the maximum has been reached we will hear less of strikes and other troubles at the mines.

In my first annual report I called attention to several important defects in the mining law, which I again take occasion to notice.

The section forbidding boys under twelve years of age (and under sixteen, unless they can read and write) provides no penalty for violating its provisions. When the law was first enacted this section was very generally respected, but since it is known that it is of no binding force, many of these boys have been taken back to the mines, in some cases the mine bosses setting the example by returning their own boys. Night-schools sprang up in a number of districts, and now most of them have gone down.

There is no penalty for failure to report accidents, serious and fatal, and very few serious accidents are ever sent me by the officers of the mine. Those of a fatal nature are not promptly reported. One case where a man lost his life in violation of the law was reported, but no inquest was held.

Only in one case have I received monthly reports of the amount of air in circulation in mines which evolve fire-damp. All such mines, however, appear to be under proper discipline, no miner being allowed to descend until the morning fire-viewer returns and reports the condition of the mine. The ventilation in all such mines has been measured by myself, and found to exceed the requirements of the law. There were but two cases during the year of accidents by fire-damp explosions, and they were both slight. It would be well to require all bosses to return monthly reports of the amount of air in circulation, whether fire-damp be given off by the mine or not. If the air is provided as the law requires, there will be little suffering in a mine from foul air.

The only penalty under the law for neglect or refusal on the part of a mine superintendent or mine owner to comply with its requirements is by a competent court enjoining or restraining the working of the mine with more than ten men at once until such mine is made to conform to the law. In most cases this action brings punishment to innocent miners by throwing them out of employment, and in times like the present men will work in any place, however dangerous, for the sake of steady employment. Where the law is violated by neglect or refusal to apply adequate ventilation, or in providing safety-gates, safety-catches, etc., the guilty parties should be punished by fine and imprisonment; but in the case of a mine immediately and suddenly dangerous to the whole population, as where but one outlet is provided, the sooner the working force is reduced to ten men the better, this number being required to drive the galleries, or work from below upward, when speed is necessary to complete a double passage-way to a mine.

One great crying want of our miners is some educational establishment wherein they might acquire a knowledge of chemistry and physics, so as to enable them to understand those natural laws with which they are hourly called to deal. The responsible managers of mines (the underground bosses) are generally selected from among the more intelligent and thoughtful of the working miners, and the great majority of them can read and write, but not one in fifty know how to use a compass in a mine, or how to plat the underground workings after they have been surveyed, nor are they able to measure the amount of air in circulation, or have ever seen an anemometer, and they virtually know nothing of the laws which govern the movement of air in mines. Every nation of Europe provides by law for the education of its master miners, and in no country but the United States is a mining superintendent allowed to assume charge of the underground departments of mines before first passing a satisfactory examination before a board of examiners, and receiving a certificate of competency.

I would earnestly recommend that provision be made by law for a mining department in the Agricultural and Mechanical College, so that the young men of the mines, equally with the farmer and mechanic, may have an opportunity of a scientific training in their art. Many young men would gladly avail themselves of such opportunity, did it exist. Coal is one of our most important elements of industry, and will continue to grow in importance for centuries to come. With better trained engineers, there would be increased saving, not alone in human life, but also in the cost of recovering the mineral resources of the earth. Already millions of tons of coal have been lost beyond the possible hope of recovery, by bad management, and thousands of dollars are annually spent to no purpose in mines, in efforts to save from threatened ruin some portions which have been made too weak, or have been otherwise unskillfully worked in laying out the mine. The teachings of all other mining states in which there have been legislative enactments for the protection of miners, and schools established for the education of master miners, is a lesson to us.

In my last report I alluded to the requirements of the law in regard to mine maps. The law requires that a report of the extended workings of a mine shall be forwarded to the Inspector every four months, to be added to the map previously provided by the company or mining operator. There can not be any real necessity for a report of extended workings oftener than once in six or even in twelve months, and if there were, it would take all the time of two expert mining engineers extending maps. Work of this kind the Inspector can not well do, for want of time. Indeed, the work alone of visiting and inspecting all the coal mines of the State, which ought to be done at least once a year (many of them ought to be examined two and three times), can not be done by one officer, if he were constantly employed in such duty alone. The work of extending maps, answering correspondence, and doing other office work, could be equally well done by a clerk in the office, which would give the Inspector more time for work at the mines.

The Inspector is sometimes obliged to apply to court to have the requirements of the law enforced and obeyed. In doing so, he must engage an attorney, and the expense thus incurred could be saved by requiring the prosecuting attorney of the county in which the mine complained against is situate to prosecute all such cases.

At the last session of the Legislature, an appropriation of $250 was made for the purchase of office furniture, and to fix up a place in the office of the Mine Inspector for the preservation of a State cabinet of the coal flora. During the past year a number of valuable coal plants were collected and sent up here from the mines, but there being no proper place to keep them, I had them sent up to the Agricultural College, and they now form part of the collection there. The money appropriated for the purpose of fixing a place for them in this office has, therefore, not been expended.

GENERAL REMARKS ON MINING AND VENTILATION.

Laying Out the Workings.—A number of circumstances and conditions require to be considered in adopting a system of working a coal mine, whether shaft, slope, or drift opening, such as the texture of the coal, as to hardness and softness, its power of resistance, the nature of the floor, the character and thickness of the superincumbent strata, the situation of water, towns, or valuable buildings on the surface, and the best method of producing the maximum quantity of coal consistent with the safety of the mine and miners, and a minimum outlay of money. There are four general systems of laying out underground workings:

1. By pillars and rooms; leaving pillars of just sufficient strength to support the superincumbent strata in mining forward. This is the oldest and rudest system of coal mining, and is now only practiced in drift-mining regions, and in shafts having a very light cover, and where the coal, floor, and roof are hard and strong, admitting of very wide rooms and very small pillars. This plan is sometimes called stump working.

2. By pillars and rooms; leaving pillars of extra size and strength in working forward, with the object of attacking and removing the pillars by working backward towards the bottom of the pit, after the rooms have all been advanced to the limits of the mine. In working home, about one-third of the coal is generally lost, partly by deterioration (the long-standing pillar coal never yielding as well as coal cut from the new, fresh face), but generally by crushes, which overrun and destroy part of the pillars as the whole seam is being cut away, or by creeps—the coal sinking into the bottom and closing up the mine.

3. By panels or squares; withdrawing the pillars of each panel after the rooms are worked forward, and allowing the incumbent strata to crush and fall in the exhausted square, while the general excavations of the mine are progressing forward. In mountainous regions, where drift mining is practiced, and the waters of the mine discharge themselves, this system is capable of general application. It is often practiced with success in deep shafts whose lower strata are comparatively free from water. Its advantages are a greater acreage of coal than in working to the boundary of the mine, and then drawing pillars.

4. By long-wall; removing all the coal as the workings progress forward, and allowing the whole incumbent strata to fall down behind and over the heads of the miners. This is the best system of all, but is only applicable to seams of moderate height and with accompanying conditions.

In the first and oldest system of mining, where all the conditions are favorable, three-fourths of the coal is sometimes mined out. A practice in British mining is to work the rooms and cross-cuts of the same width, and to leave the pillars in square blocks of the width of the rooms. To add strength to the pillars, they are sometimes left diagonally, like the blocks of a checker-board. When the workings are advanced forward to the boundary of the mine the workmen withdraw their tools, no attempt being made for the recovery of any part of the coal left standing. In mines where the conditions are less favorable, the pillars are left of greater thickness and strength in working forward, and after all the rooms are worked out they are pared down or winged, until a crush comes on and overruns the whole mine. This system has now very generally gone out of practice, and prevails only in regions where coal is accessible by drift openings, and where coal lands are abundant and cheap.

The second system, of working with pillars of extra strength and size, with the object of attacking and removing them after the rooms are all advanced to the boundary of the field, is also fast giving way before more approved methods. In working over large areas, where the pillars have to stand for a series of years, it frequently happens, particularly with coal of a soft and free nature, or where the floor is soft and yielding, that some part of the mine gives way, producing a crush or creep. Or, if the pillars stand firm till they are attacked in working home, part of the mine, during their removal, is generally overrun to a greater or less extent. Besides, long-standing pillars never produce as good coal as those of recent construction. Under the most favorable circumstances there is a great waste in mining in the second as well as the first system.

The system of working by panels or squares was devised about the year 1830, by John Buddle, of Wallsend, England, to whom the British nation is indebted for a number of valuable mining improvements. Instead of carrying forward the workings to the boundary of the mine before attacking the pillars, as practiced in the ordinary method, Mr. Buddle laid out the workings in this new system in quadrangular panels, each panel covering ten or twelve acres of ground and including sixteen rooms, and leaving on all sides of the square a solid wall or pillar of coal of varying thickness, according to the depth and nature of the overlying rocks, and the powers of resistance of the coal and floor of the mine. Air-ways and hauling roads were cut through the panel walls at proper intervals, and the rooms started off from the inner parallel gallery were advanced on the face or the rise of the coal till they reached the extremity of the square, when the pillars were attacked and withdrawn, and the superincumbent strata allowed to close in.

The panel system is modified in different mining regions in accordance with varying conditions. Where the mines are level-free and the cover of the coal is light, the rooms may be made larger and the pillars and panel walls smaller, and where there is no discharge of inflammable gas, if a vigorous ventilation prevails, there may be no occasion to make cross-cuts or thirlings for air, every seventy or eighty feet apart. In shallow shaft mines, however, where a break in the rocks of an exhausted panel might cause such an inflow of surface water as to overpower the capacity of the pumps, prudence would suggest advancing to the boundary of the field before the attack was made on the pillars.

As the sole object in leaving pillars in every system of pillar-working a mine, is to prevent a crush or creep of the workings, these supports should invariably be made of extra strength and thickness; not with the view alone of supporting the mine as the workings progress forward, but to prevent the possibility of a crush or creep extending over the pillars, after part of the mine becomes weakened by their partial withdrawal. While the nature of the coal, and of the roof and floor of the mine, vary greatly in different coal regions, requiring larger or smaller pillars, according to the accompanying conditions, a mistake can scarcely be made on the side of amplitude in the mine supports. On the other hand, crushed and lost coal, dilapidated roads, closed air-courses, the contraction of the productive power of the mine, and an everlasting expense for repairs, are the sure accompaniments of weak pillars in the later stages of mining. In deep mines, to reach the coal of which an enormous outlay in sinking is required, the precaution of leaving strong pillar supports is now seldom, perhaps never, neglected. In the Monkwearmouth pit, in England, upwards of eighteen hundred feet in perpendicular depth, four-fifths of the coal is left in pillars in the first working, but nine-tenths of the whole is sought to be recovered in working backward.

No rule can, however, be laid down as to the proper size of pillars and the width of rooms in any system of mining coal by pillar workings, as the conditions and circumstances of the various districts are so different. Even in the same district, and in the same seam of coal, these conditions vary greatly. In one region the coal is soft and friable, and disposed to crumble and fly off at the pillars, as soon as they become exposed to any crushing weight; in another region, the coal is hard and compact, and the pillars of the mine are capable of powerful resistance. In some mines the roof is soft and brittle, invariably forbidding wide workings; in others, the roof and coal are hard and strong, but the bottom is soft and yielding, and the pillars, if left too weak, sooner or later sink into the floor, producing a creep which overruns the mine. The deeper the mine is sunk from the surface, or the thicker the cover over the coal, the greater is the crushing weight to which the pillars are exposed. Leaving large pillars in a mine entails additional expense in advancing the workings, because the narrow work of entry driving must in all cases be paid extra; hence there is a temptation to make the pillars too small, for the sake of immediate returns.

Mr. Dunn, in his "Working and Winning of Collieries," gives the following general table for increase in pillars, in proportion to the increasing thickness of overlying strata. In the table the rooms are supposed to be five yards wide, and the cross-cuts two yards wide:

Fathoms.	Size of pillars in yards.	Proportion in pillars.	Fathoms.	Size of pillars in yards.	Proportion in pillars.
20	20 by 5	.41	180	26 by 14	.69
40	20 by 6	.50	200	26 by 16	.71
60	22 by 7	.52	220	28 by 18	.73
80	22 by 8	.57	240	28 by 20	.75
100	22 by 9	.59	260	30 by 21	.77
120	22 by 12	.61	280	30 by 22½	.78
140	26 by 15	.63	300	30 by 24	.79
160	28 by 16	.66	In Wearmouth.	40 by 29	.80

Coal seams are generally divided and intersected at short, regular intervals by partings or cutters, called face and butt slips, which cross each other at right angles like latitude and longitude lines. In working by pillars and rooms, if the seam of coal to be won lies in the ground in a comparatively flat or level position, and the conditions of mining will admit it, the main galleries are driven forward along the face-slips of the coal, and a series of galleries, each from three hundred to six hundred feet apart, according to the varying circumstances and conditions of different mining regions, are struck off from both sides of the main galleries, and driven along the line of direction of the butts, or end-slips of the coal. The rooms are struck off from the butt entries, and are advanced in parallel lines along the face of the coal, a pillar of coal being left between each room for the support of the superincumbent rocks. Where the coal bed dips in the direction of the face of the coal, the main entry is worked to follow a level course, without regard to other conditions, but an aim is always made to drive the side entries on the butts, and to work the rooms on the face, as the coal, in nearly all cases, is easier mined on the face.

In general cases the entries of a mine, side and butt alike, are cut very narrow, generally about eight feet wide, to give security to the roof and strength to the mine; but there is very great diversity in different regions as to the width of the rooms and the thickness and size of the pillars. Rooms vary from twelve to forty feet in width, and pillars from six to forty, and even sixty feet in width, according to the depth of the superincumbent rocks, the nature of the roof, the power of resistance of the pillars, and the character of the coal floor.

In the long-wall system of mining, all the coal is cut away as the workings extend progressively forward; but this plan is limited to circumstances. Wherever the conditions exist favoring this method of mining, it should be preferred to all otners. The late Mathias Dunn, British Inspector of Mines, gives the following conditions under which the long-wall system may be adopted:

> "1. If the coal be thin, hard, and capable of bearing pressure, or the top and bottom be soft, requiring a considerable quantity of cutting for the necessary tram height.
>
> "2. If band or rubbish be mixed with the coal, requiring to be stowed underground, so as to furnish a cheap and plentiful supply of *debris* for filling.
>
> "3. If the distance from the shaft to the boundary line be limited.
>
> "4. If the roof be free from water, and the workings clear of buildings, rivers, etc.
>
> "5. If the roof contain ironstone, to be worked with the coal, thereby producing much refuse, or if it be so soft and brittle that it will not stand for ordinary pressure.
>
> "Under these and many other circumstances the long-wall system may be recommended. There may, however, be objections, rendering such workings impracticable, viz:
>
> "1. If the workings produce a considerable quantity of inflammable gas, either from the seam itself or from some superior seam.
>
> "2. If the roof contains water, the letting down of which would spoil the tram-ways or overpower the engine and pumps.
>
> "3. If the coal be so near the surface that the long-wall workings would have the effect of damaging buildings.
>
> "4. If the cuttings of the roof or floor for height are so soft or friable that they would not be sufficient to support the roads, in which case the expense of setting additional props or obtaining other material may exceed the value of the coal, or its cost by another system.
>
> "5. If the seam be deep, and from its thinness suitable for long-wall, yet the small quantity ordinarily producible from one establishment may render its workings unprofitable; or, in other words, the maintenance of expensive roads or the number of pits required may not be repaid by the working thereof."

The system of long-wall working is very largely followed in Scotland, fully fifty-five per cent. of all the coal raised in that country being got on the long-wall method. In Shropshire, Derbyshire, and Leicestershire, and several other mining regions of England, it is the favorite manner of mining. It is also adopted in many of the mines of South Wales, and is extensively practiced in Belgium and Saxony, on the continent of Europe.

To obtain the full benefit of working out coal by the long-wall system, the line of direction of the wall-faces should be at right angles with the face-slips of the coal seam. Under ordinary circumstances, the coal never works as well when the walls are advanced on any other course. In deep mines, however, when the bed of coal is very tender, the heavy, overlying pressure breaks up the coal too fine in working forward on the face, and better results are obtained by advancing the walls on the butts.

Seams of coal which have bands of slate running through the body of the coal, or have a "falling" of shale, which comes down as the coal is mined out, are best adapted for long-wall, as this refuse material alike serves for stowing away in the gob-waste and for building the pack-walls for the maintenance of the roads.

In laying out the workings of a mine on the long-wall method, a strong, square pillar of coal is left around the bottom of the pit, to preserve the shaft from becoming involved in the break of the stata which follows the removal of the coal. Double entries are then advanced forward on both sides of the shaft, and on the butts of the coal, if the conditions will admit of it; if not, on a water-level line. The lower entry serves for a permanent air-way; the walls are struck off from the upper one, and are advanced upon the face of the coal, one wall following the other in echelon, and having each a loose end. The width of the walls are various, to suit varying conditions, but they generally range from twelve to forty yards. In some mines there is a wall-face of three or four hundred yards extended in a straight line; and sometimes a line of face is formed like the arc of a circle. The general plan, however, is to advance the walls in echelon.

The roads of the mine, which are made from six to eight feet wide, are maintained by building pack-walls on each side of the road. The material for this purpose is got out of the roof or floor. The refuse coal and *debris* of the seam, such as clay partings and dirt bands, are thrown back in the gob-waste, to receive and resist the crushed and falling roof strata. In some cases, where suitable material does not exist in the mine for building the pack-walls, it is brought down from the surface, but this adds greatly to the expense of getting the coal. The thinner the seam of coal is, and the more refuse it makes, speaking in general terms, the better it is adapted to the long-wall system of mining.

Care and skill require to be exercised in building the pack-walls of the hauling roads. If these walls are not well built, or if they are constructed of material of a soft and friable character, the weight of the overlying rocks, during the subsidence of the strata, will crush and squeeze them, and entail a great expense in keeping up roads. Unless the mine is also kept running constantly and regularly, the roads are very difficult to keep in repair, and the wall-faces become choked up by the falling of the roof.

In excavating the coal by the long-wall system, the miners make it a point to have a day's coal undermined before leaving work in the evening. During the night, the undercut wall-faces, exposed to the weight of the roof, loosens the coal, so that it often falls down before the workmen return next morning. The new made fresh roof stands firm, supported by a double row of props at the point of the last break, until a new set of props is placed nearer the face, and the outer set withdrawn, allowing another break of the overhanging strata to close down on the gob-waste.

The advantages of the long-wall system over any method of working by pillar and room, consist in the extraction of the whole of the coal, and in the simplicity of the manner of mining, and means of providing and maintaining ventilation. Where the mines are deep, and the coal is reached only by a great outlay of money in sinking, this system of mining, even if it cost more, ton for ton, than the common method of pillar and room, will save in the end, in the greater yield of coal to the acre.

Where the conditions are neither favorable to the system of long-wall nor to any general plan of pillar and room-working, as where the seam is soft and friable, and lies under a deep and treacherous cover, the coal is sometimes recovered by driving forward the galleries of the mine to the boundary of the field, and working backward towards the bottom of the shaft. This plan entails a long delay, after coal has been reached, before any profits are returned on the mining adventure; but its advantages consist in a thorough control over the ventilation of the mine, in a greatly lessened cost in maintaining roads, and the avoidance of the possibility of a crush or creep of the workings. In working backward, the long-wall system or a suitable plan of pillar and room may be adopted. This system of opening up a mine is to be commended above any other, but its failure to produce immediate returns will always prevent its general application.

In Germany and other states of continental Europe, where the minerals are owned by Government, the main object considered in the development of the property is the greatest possible extraction of the mineral treasures of the earth. In Great Britain, where the owners of coal and other mineral property seldom operate the mines themselves, but lease to companies, care is taken by the owners, in drawing up leases, to prevent any useless waste of coal by bad working; and the mining viewer, employed by the land owner, appears in the same relation as the Government inspector on the Continent. In the United States, however, the minerals and land both are almost always owned by the mining operators; and as mineral property is cheap and abundant, the great object is to mine out the best coals in the cheapest manner possible, without regard to ultimate consequences. As a consequence, we are wasting our valuable mineral treasures in a most shameful manner.

Gases of Coal Mines.—Mines which are shallow, such as drift mines or shafts of less than one hundred feet in depth, seldom, if ever, give off fire-damp in any alarming quantity, it doubtless having escaped long ages ago where the coal beds have been laid bare by the erosions of the land. It is generally met with in greatest abundance in shafts ranging from six hundred to twelve hundred feet in depth. It frequently escapes in the form of blowers, which produce a hissing noise, and which, when ignited, burn like a long blow-pipe. As it exists in a highly compressed state, being pent up by the counterpoising pressure of the atmosphere, any lightening of atmospheric pressure, as indicated by the fall of the barometer, is a sure presage of an unusual flow of gas.

As wherever the fire-damp accumulates to the point of an explosive mixture a naked light can not be used amongst it, several ingenious methods have been devised to light the workings of mines without producing an explosion of fire-damp. In the early ages of mining, when the miner ventured only a few hundred feet into the bowels of the earth, the reflection of the sun's rays, by means of a mirror, was practiced to throw forward light. The steel mill, invented by James Spedding, of Whitehaven, in England, in the year 1775, was used for many years. This machine, which consisted of a small iron frame, upon which two wheels were mounted, to one of which there was attached a piece of flint, threw a succession of sparks of fire during the revolution of the wheels, and yielded a miserable glimmer of light. It required one man to operate the mill to give light to a single workman, and sometimes explosions of the inflammable air occurred from the flying sparks. Since, however, no better means were known of lighting the underground workings in an explosive mixture of fire-damp, this machine was in very general use until the discovery of the safety-lamp, by Sir Humphrey Davy, in the year 1816.

In 1812, in consequence of a dreadful explosion of fire-damp which occurred at the Felling colliery, in England, by which ninety-two human beings were scorched and suffocated to death, a society of gentlemen was organized for the purpose of instituting inquiries into the causes of coal mine accidents. The meritorious exertions of this association attracted the attention of Sir Humphrey Davy, and in 1815 he visited the coal mines of the Newcastle field, where he was introduced to John Buddle, the ablest mining superintendent of his day. Mr. Buddle collected various specimens of the fire-damp from the mines, and sent them to Sir Humphrey, in London. After a series of elaborate investigations, Davy made the discovery that flame would not pass through small tubes of wire gauze containing twenty-eight holes for each inch in length, or seven hundred and eighty-four apertures to the square inch. He then inclosed a small oil lamp in a cylinder of wire gauze, and presented it as a gift to the miners of Great Britain. Mr. Buddle and other mining engineers immediately put its security principles to the most searching practical tests. In a letter complimenting Sir Humphrey on the discovery, Mr. Buddle said:

> "Besides the facilities offered by this invention for the working of coal mines abounding in fire-damp, it has enabled the directors and superintendents to ascertain with the utmost precision both the presence, the quantity, and correct situation of the gas. Instead of creeping, inch by inch, with a candle, as is usual, along the galleries of a mine suspected to contain fire-damp, in order to ascertain its presence, we walk boldly forward with the safety-lamp, and with the utmost confidence prove the actual state of the mine. By observing attentively the several appearances upon the flame of the lamp, in an examination of this kind, the causes of accidents which happened to the most experienced and cautious miners is completely developed, and this has hitherto been in a great measure matter of mere conjecture.
>
> "It is not necessary that I should enlarge on the national advantages which must result from an invention calculated to prolong our supply of coal, because I think they must be obvious to every reflecting mind. But I can not conclude without expressing my highest admiration for those talents which have developed the properties and controlled the power of one of the most dangerous elements which human enterprise has hitherto had to encounter."

Sir Humphrey was complimented on all hands. In March, 1816, he received as a gift an elegant service of plate from the coal mine proprietors of the Newcastle coal field, and was at the same time the recipient of a public address, of which he was very proud, by the working miners, thanking him, in behalf of themselves and their families, for a discovery tending to the preservation of their lives. In 1825 he also received from the Emperor Alexander, of Russia, in compliment of his invention, a superb silver case standing on a circular tray enriched with medallions, and on the cover there was a figure representing the God of Fire weeping over his extinguished torch.

After the discovery of the safety-lamp, many mines which had been abandoned on account of the flow of fire-damp were reopened, and millions of tons of coal recovered.

George Stephenson, the celebrated engineer, invented his safety-lamp, the "Geordie," about the same time as Davy, and contested with Sir

Humphrey for priority of invention, but the credit was awarded to Davy. It appears that these two men, unknown to each other, had arrived at the same results. Stephenson's lamp had both gauze and glass around the flame, and possessed one advantage over that of Davy's—it became instantly extinguished when the gas was fired. In the hands of inexperienced fire-viewers, and in mines where safety-lamps have to be exclusively used, the "Geordie" is preferred to the "Davy," as being the safer lamp of the two; but for detecting the presence of fire-damp, the "Davy" is regarded by the ablest practical engineers as the best lamp yet invented. Mr. Stephenson was rewarded, like Davy, with suitable presents and public thanks; and though he failed to establish priority of discovery, the fact that he had, without any chemical knowledge whatever, and with scarcely any education, arrived at the same results as the distinguished chemist, was recognized and appreciated throughout the United Kingdom. Mr. Stephenson thus explains the manner by which he arrived at this discovery:

> "I was in the habit of making experiments upon blowers, and found that when they were lighted, and a number of candles held to the windward of the lighted blowers, the blowers were put out by the burned air which was carried towards them. Hence I conceived that if a lamp could be made to contain the burned air above the flame, and to permit the fire-damp to come in below in a small quantity, to be burnt as it came in, the burnt air would prevent the passing of explosion upwards, and the velocity of the current would also prevent it passing downwards."

When a Davy's safety-lamp is brought in contact with an explosive mixture of fire-damp, the gas explodes inside of the lamp, but does not ignite the gas outside, because the flame inside of the cylinder is unable to pass through, as the wires of the cylinder cool the burning flame sufficiently to prevent it from setting fire to the inflammable air outside. The burning gas inside of the cylinder, however, were the safety-lamp allowed to remain among the fire-damp, would soon heat the wires red hot and burn them through, when an explosion would follow. A current of inflammable air, moving at the rate of seven feet per second against a safety-lamp standing stationary, will also cause an explosion. Hence it will be seen that absolute safety is not attained by this invention. On the contrary, more men have been destroyed by explosions of fire-damp since the discovery of the safety-lamp than ever before. The lamp has in many cases been taken for license to neglect the ventilation—the best safeguard of all—and miners continue to tamper with it, notwithstanding the well-known danger and the most severe pains and penalties of law.

A great number of safety-lamps have been patented since Davy and

Stephenson made their discoveries. One by Dr. Clanny, called the "Clanny," is esteemed by fire-viewers, and is in very general use. In Belgium the Musseler lamp is the favorite. They are all covered by the wire-gauze cylinder. The great objection to every kind of safety-lamp is the feeble light they give, which tempts the miners to take off the top or gauze, and risk the consequence of an explosion.

Before the discovery of the safety-lamp the presence of fire-damp in coal mines was ascertained by the miner creeping cautiously forward along the mine, holding a lamp or candle in one hand and screening the flame with the two forefingers of the other, meantime keeping his eye intently fixed on the top of the light. As he reached the explosive compound, the top of the flame began to elongate and to assume a color of grayish blue. He stops at this juncture, and slowly raises his light towards the roof where the fire-damp floats. The flame now elongates into a sharp spire, the top changing from a grayish blue to a pure fine blue, and giving off minute luminous sparks. This is the extreme point of danger; a sudden movement of the body or a quick lowering of the lamp would cause an explosion. The miner lowers the lamp with great caution, and extinguishes the flame with his thumb and finger. This experiment, termed "trying the candle," was one of extreme peril, and was entrusted only to the more cool-headed of the miners. If the gas was not very copious, it was fired by means of "the firing-line." A light was attached to the end of a cord, that passed over a wheel at the wall-face; the light was then drawn into the fire-damp, while the miner retreated to a safe distance. Sometimes the miner would wrap himself in a wet jacket, and stretching himself flat on the floor would raise his light and explode the gas over his head. In France this person was sometimes called the penitent, as his head was covered by a mask resembling a monk's cowl, but he was more generally named the cannonier of the mine.

An explosion of a large volume of fire-damp in a coal mine is indeed a fearful catastrophe. The mine may be one thousand or one thousand five hundred feet below the surface, its various rooms and galleries extending several miles underground. Two or three hundred men and boys are at work. Some miner carries a naked lamp amongst an explosive mixture of inflammable gas. A terrific explosion follows. The burning air rolls like a tornado along the galleries of the mine, scorching every living creature to death within the reach of the blast. The divisions of the mine beyond the reach of the fire are visited by the force of the explosion; doors are broken to pieces, stoppings are blown down, men and horses are dashed to the ground, the cages in the shaft and even the pulleywheels are thrown high in the air. The choke-damp, the product of the explosion, strides through the mines and completes the work of death.

Black-damp, when it accumulates in a solid stratum, lies heavily upon the floor of the mine, sometimes for two or three feet in thickness, while the air above may be comparatively pure. It, however, readily diffuses itself with the common air. This gas has its sources from the lungs and bodies and excrementitious deposits of men and animals, the combustion of the workmen's lights, decaying timber, explosions of blasting-powder, and it also exudes from the fissures of the coal, and from the roof and floor of the mine. In its pure state it is a most deadly poison, and will neither support light nor life; but when diffused with certain proportions of atmospheric air, human life will exist for some time, even where the miners' lamps can not be kept burning. Carbonic acid gas was formerly called fixed-air by its discoverer, Dr. Black, of Edinburgh, from its existing so copiously in limestones and other solid substances. In a solid state carbon constitutes the diamond; charcoal and anthracite coal contain as high as ninety per cent. of carbon.

This gas, diffused through the air of coal mines, is, perhaps, ultimately more dangerous and deadly to the miner than even the fire-damp. It is insidious in its operations, and kills the workmen by inches. Its immediate effects are headache, langour, and general depression. Mines which give off no fire-damp are generally in a worse state of salubriousness than those which yield inflammable air. Where fire-damp exists, a sweeping current of air is generally made to traverse the working-faces of the mines, so as to dilute the gas and render it harmless; but where black-damp only is generated, the main object in too many cases seems to be, not to sweep the working-faces with a moving current of fresh air, but to provide just as much ventilation as will preserve the workmen's lights from dying out. And thus it is that, hourly plunged in a deleterious atmosphere, so many miners never grow old, but die.

White-damp is seldom met with in coal mines from natural causes, and is mainly produced from explosions of blasting-powder and from fires. When inhaled, it produces headache, giddiness, fainting fits, and insensibility, even when mixed with its own bulk of common air. In ancient times, when fires were used in mines to render the rocks brittle, the miners suffered greatly from the effects of this gas. Agricola, a German mining author, who wrote in the year 1556, describes at length the sufferings of the miners, induced by breathing the atmosphere of mines in which fires were used. The men were afflicted with headaches, difficult breathing, and sore eyes, and would sometimes fall back from the ladders when climbing up the shaft after the toils of the day, overcome by the dangerous emanations of the mines.

The Edinburgh Review, in an article on the mortality of trades and professions, referring to the diseases of the miners, says:

> "The miner's supply of oxygen is small; for, in all probability, the air supplied to him has to circulate many miles through the mine, and to pass over the excrementitious deposits of man and horse, and the decaying wood-work of the mines, ere it finally reaches him in enfeebled streams in his solitary working cell. Long deprivation of solar light, again, tends to impoverish his blood, to blanch him, in short, like vegetable products similarly deprived of the light of day. It is through the lungs, however, that the health of the miner is principally attacked. The air of a coal mine, such as it is, holds a vast amount of coal-dust in mechanical suspension, and this, as a matter of course, is constantly passing into the lungs of the miner. The proof of this is the so-called 'black spit' of the collier, which, on being subjected to the microscope, is found to consist of mucous filled with finely divided particles of coal. The permanent inhalation of such an atmosphere results in what is termed the 'black-lung.' The breathing apparatus of the collier becomes clogged, in short, with coal-dust, and after death has the appearance of being dipped in ink. The presence of this foreign body in the lungs leads to the whole train of pulmonary diseases. Asthma, bronchitis, and pneumonia are but too frequent, and we are, consequently, not surprised to hear that the aggregate amount of sickness experienced by this class for the period of life from twenty to sixty is ninety-five weeks, or sixty-seven per cent. more than the general average."

The more common diseases to which miners are subject are, sub-acute rheumatism, or chronic pains of the trunk and limbs, more particularly the back and loins, and affections of the chest and lungs. Rheumatic complaints are induced by working in water, or are caused by sudden changes from the mild temperature of the mine to that of the outside in cold weather; and diseases of the lungs result from breathing the foul air of the mines. When miners are attacked in their lungs, the shoulders rise, making the head look like sinking, as in ordinary consumption; the breathing apparatus becomes clogged up, and there is expectorated a black spit, which finally results in the black-lungs, or coal-miner's consumption.

Prof. Graham examined the lungs of a miner, the greater part of which were obliterated with a black, solid matter like lamp-black, and above an ounce of charcoal was obtained out of the mass.

Dr. William Thomson has recorded a number of cases of miners' lungs which were infiltrated with black matter. The following are some of the cases:

D. C. Age fifty-eight years; miner twelve years; lungs uniformly black and of a carbonaceous color.

D. D. Age sixty-two years; miner from boyhood; lungs uniformly black, not a vestige of natural color left; refers his disease to breathing an irrespirable atmosphere.

G. H. Age forty-five years; lungs uniformly deep black through their whole substance, with a density equal to caoutchouc.

L. A. Age fifty-four years; miner all his life; whole lungs dyed with black matter.

> "Although pathologists do not agree," says Dr. Hutchinson, "about the exact cause of the origin of this carbonaceous matter—whether caused by mechanical inhalation of black matter, or by a chemical action of breathing carbonic acid gas, matters little to the miner. All agree that the lungs are blocked up with carbonaceous matter—by pit air—by something peculiar to the art of mining; and all agree that the more pure the air the more healthy the lungs. This allows me to urge for more air to circulate, for better ventilation, upon sanitary grounds alone."

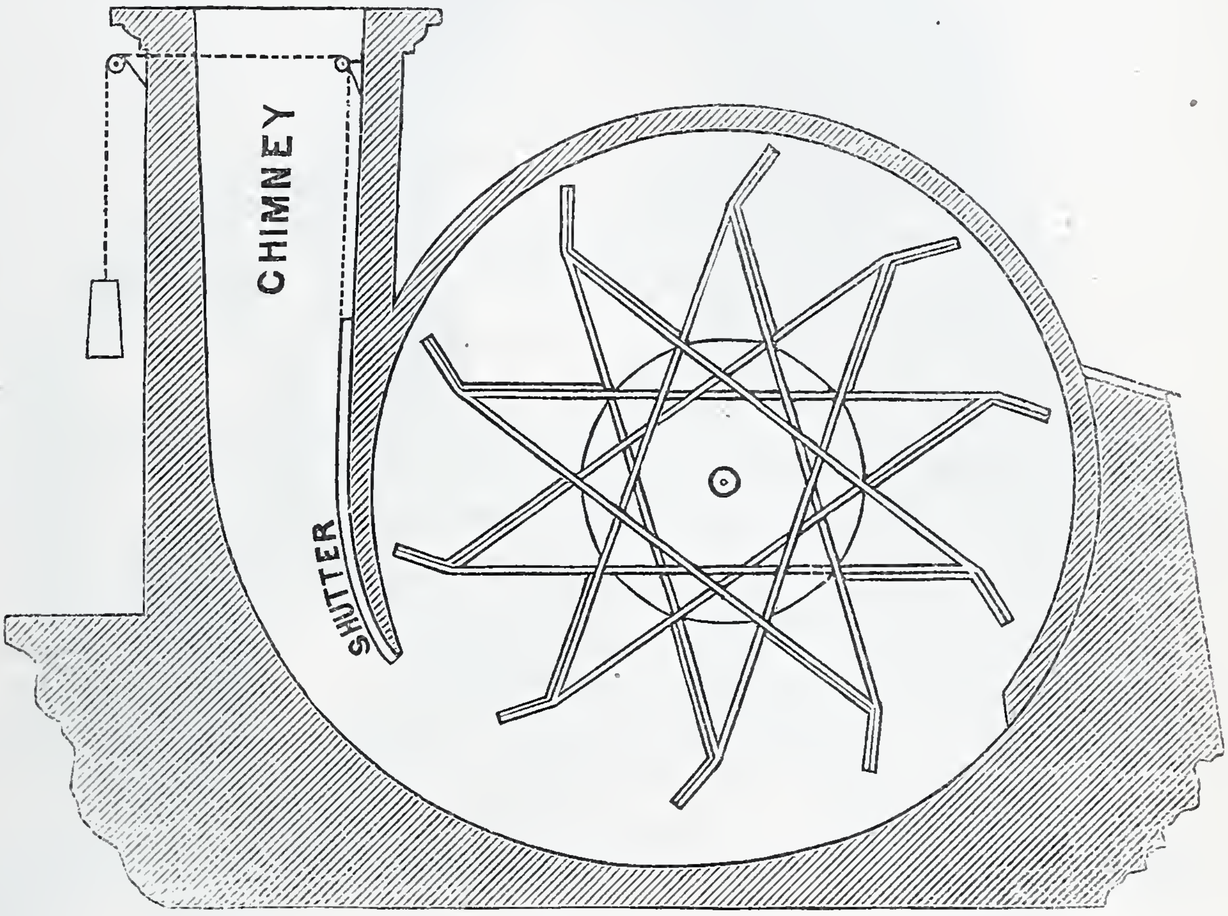
Ventilation.—Where two shafts or other openings are made into a mine of the same depth, and the tops and bottoms of both are in the same level, there can be no movement of air in the mine, even if the mine air and that of the surface be of different densities, because the pressure of the atmosphere in both shafts is equal; but if one of the shafts is sunk in higher ground, and is consequently deeper than the other, there is always a natural motion of the air, provided the temperature of the mine and that of the surface is of different densities. In winter, when the air of the mine is rarer and lighter than that of the surface, the current flows down the lower opening and up the higher one; and in summer these conditions are reversed, because the cooler column of air is then transferred to the higher opening. At certain seasons of the year, when the atmosphere above ground and that of the mine approach each other in density, there is again no motion, except what may be produced by the action of the cages in the shafts, or the movement of the cars along the galleries of the mine, or the direction and force of wind on the surface. In the language of the miners, the "pits fight"—the ventilating current sometimes going down one shaft, and in a few minutes reversing itself and going down the other; but in such cases it is weak and languid, and often assumes a state of rest. The unassisted forces of nature at such seasons of the year are wholly insufficient to create a current of air for the supply of even the smallest mines.

In very deep mines, where the increasing heat of the rocks maintains the temperature of the mine all the year round above the summer heat of the surface, the natural flow of air is constant in one direction, entering the lower opening and discharging itself at the higher one. It is, of course, very feeble in summer and very strong in winter. Hetton Colliery, in England, has been found to produce one hundred thousand cubic feet of air per minute on a cold winter day, by the natural forces.

The powers applied for the purpose of creating and maintaining a constant and necessary current of air in mines when the natural forces fail, are many and various. The earliest means used for renewing the air of mines, we are imformed by Pliny, was by diligently shaking a piece of cloth at the entrance of the mine. Fans and air-pumps were in general use in Agricola's time, and are described at length by that author. Some of these machines were capable of extracting the foul air from passages a quarter of a mile in extent. Waterfalls were formerly employed in coal mines to give motion to the air. A stream of water was poured into the downcast shaft, but as it had to be pumped out again it was let on very sparingly, and was a very expensive method. Steam jets were proposed by Sir Goldsworthy Gurney, in the year 1848, and for a number of years after were in high favor, as the danger in fiery mines of an explosion of fire-damp was avoided by the foul return current passing over the furnace, and they were believed also to produce better results than the furnace. But after an elaborate series of experiments, instituted by some of the ablest mining engineers of Great Britain, they were found to be greatly inferior to the furnace as a ventilating power, and are now very generally gone out of practice. Since the introduction of steam-pumps to discharge the waters of mines, exhaust steam is frequently used to promote a current of air, but although wholly inadequate to produce a vigorous ventilation, it is, in shallow mines, a great auxiliary to the furnace, and can be applied without any expense whatever.

Exhaust fans have long been the favorite ventilating power on the Continent of Europe, and they are now coming into practice in England and the United States. In Belgium the law forbids the use of a furnace in a fiery mine, and since the passage of the mines inspection law of Pennsylvania, which followed the Avondale catastrophe, the fan has become quite a favorite in the anthracite coal region. This accident, by which one hundred and nine human beings lost their lives, resulted from the furnace setting fire to the wooden structures in and on top of the shaft. The "Ventilation Act" provides that "the ventilation may be produced by blowing-engines, air-pumps, forcing or suction fans of sufficient capacity and power, or other suitable appliances, so as to produce and insure constantly an abundant supply of fresh air throughout the entire mine; but in no case shall a furnace be used in a mine where the breaker and shute buildings are built directly over and covering directly the top of the shaft." Guibal's fan is preferred to all others. It is generally made from fifteen to thirty feet in diameter, and from six to twelve feet wide, according to the requirements of the mine. It is inclosed in a case, having a stack from twenty to thirty feet long, extending upward.

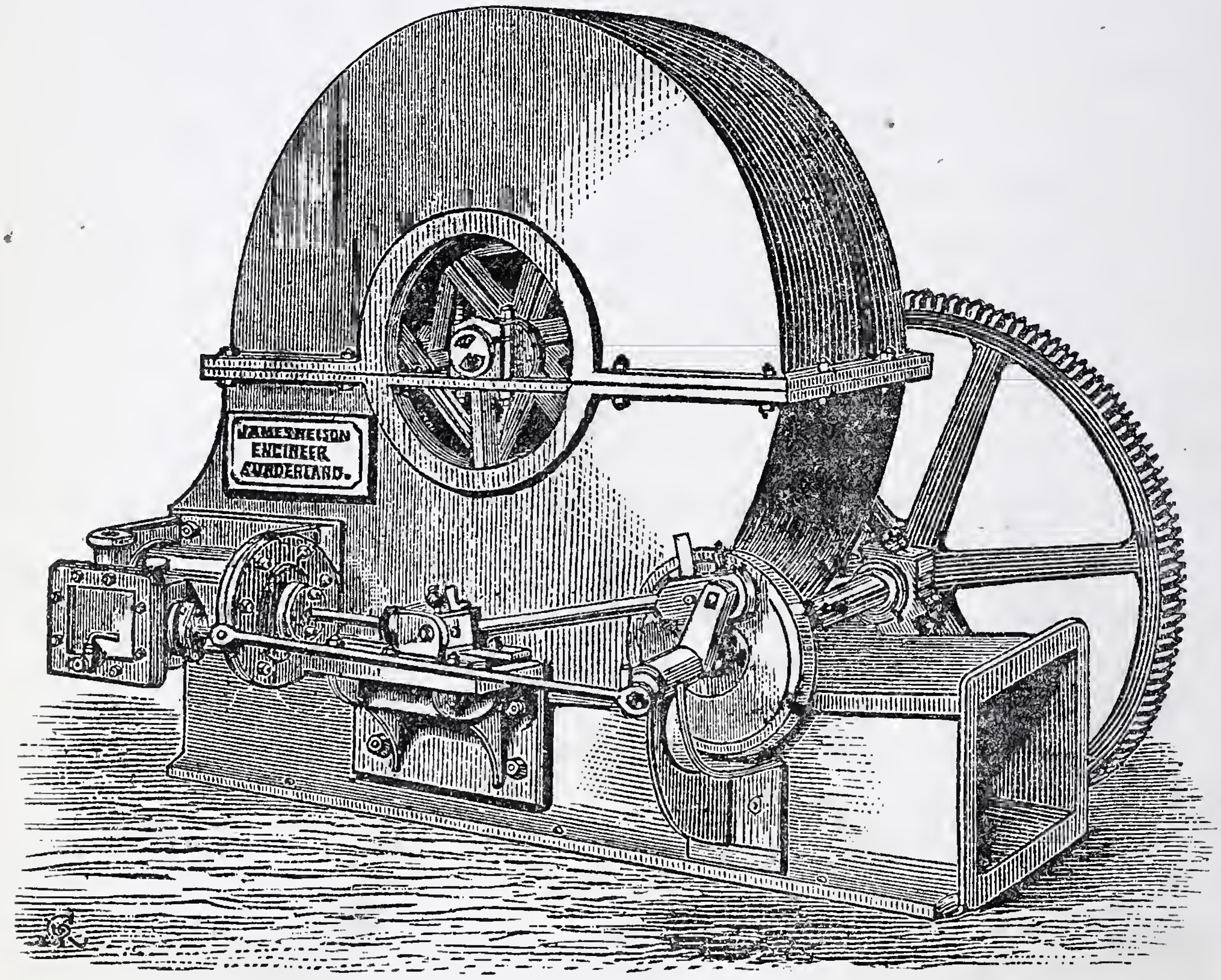
One of the largest mine ventilators in the world is a Guibal fan, forty-five feet in diameter and twelve feet face, at the Usworth Colliery, near Newcastle-on-Tyne. This fan runs about forty revolutions per minute, and is said to circulate two hundred thousand to two hundred and fifty thousand cubic feet of air per minute. It is driven by two first motion engines, thirty-six-inch diameter cylinders, three feet stroke. The upcast shaft is about ten feet in diameter, and six hundred feet deep. The workings in three seams are ventilated through it. The output of the Usworth Colliery is one thousand five hundred tons per day. The mines are very extensive. All the underground haulage is performed by macinery. Two of the three seams are worked on the board and pillar system; the other is worked on the long-wall plan.



GUIBAL'S FAN.

The Guibal fan at St. Hilda's Colliery, South Shields, lately constructed, is the largest fan of the kind yet erected in England; its diameter being fifty feet, and its width twelve feet. The patentee, Mr. Morrison, engaged to produce a sufficient ventilation for those extensive works, the Harton and St. Hilda's Colliery, by the action of this great fan, with a speed of twenty-eight revolutions per minute. It is found, however, that with a speed of twenty-two revolutions per minute the ventilation is amply sufficient for the purpose, and a much larger quantity of air is circulated at that speed than was formerly got by the furnaces. As the fan can be worked up to fifty revolutions per minute, the quantity of air can be greatly increased should any emergency arise to make it necessary to work at greater speed.

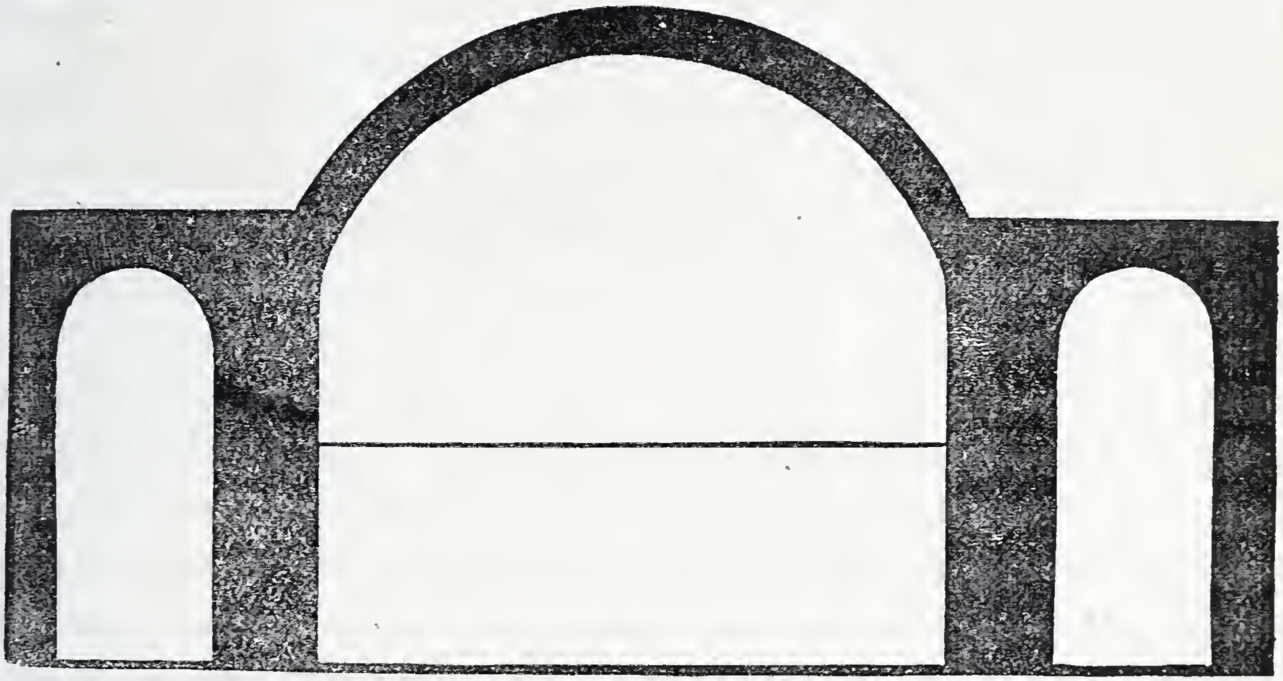
The Lenielle and Fabry fans are used in many mines in France and Germany, and Nixon's and Struve's ventilating pumps are at work in England and South Wales; but one serious fault to all mechanical ventilators is their liability to get out out of order and stop. In fiery mines this is considered by many able, practical men a fatal objection, because the stoppage of the ventilating currents, even for a few minutes, would flood the workings with gas, and imperil the lives of the whole underground population. For shallow mines, however, and mines which give off no inflammable gas, the fan is the best ventilating power in use.



IMPROVED FAN AND ENGINE.

The furnace has long been the favorite ventilating power in Great Britain and the United States, by reason of its simplicity and certainty. It is most effective in deep mines, because its power depends upon the amount of heat communicated to the air, and the longer the column of heated air there is in a shaft, the greater the velocity of the ventilating current becomes. This practical fact is not as well understood among practical men as it should be, and many a shallow mine is poorly ventilated, because, in addition to the physical imperfections of a shallow shaft, there is added a correspondingly small furnace. Mr. J. J. Atkinson, in his practical treatise on the general principles of ventilation, says: "Where furnaces are used to produce ventilation, the deeper the upcast shaft the better; because this gives rise to a longer upright column of hot air, and so causes a greater ventilating pressure, and, consequently, a brisker ventilation. Furnaces are not well suited for causing ventilation in shallow mines for this reason, and sometimes machines are fixed up at the top of the pit to pump the air through the mine. These machines, for the most part, exhaust the air of the upcast shaft, and the pressure of the denser air in the other, or downcast shaft, causes the current. Such a machine, like a furnace, acts by rendering the upcast column of air lighter, bulk for bulk, than the air in the downcast."

The proper place for the ventilating exhaust-fan is at the top of the upcast shaft; while the proper place for the furnace is at the bottom of the upcast shaft. Furnaces are sometimes placed on the top, but it is a mistake, no matter how limited the requirements of the mine may be. The best place for the furnace is back from the bottom of the upcast one hundred or one hundred and fifty feet, so as to avoid the danger of setting the wood-work of the shaft on fire. Many a fatal mining catastrophe has been caused by the too close proximity of the furnace to the woodwork of the upcast, of which the Avondale horror may be cited. The passage-way from the furnace to the air-shaft should be made to slant upwards, if it can be done, and should be of the same area as the airshaft, and both should be proportioned to the size of the furnace. A large furnace and upcast shaft, with narrow air-ways, or spacious airways with a small furnace and upcast, can not produce good results.



FURNACE.

Where the air-courses are of thirty-six feet of sectional area, the furnace should be at least six feet wide and three feet high above the bars. A wide furnace will do better service than a high one of the same sectional area, because it admits of a thin fire, which more effectually heats the passing column of air. It is not necessary that the upcast shaft should be as large as the air-ways, as the sides of the shaft in too large an upcast do not become sufficiently heated, and a small shaft confines the ascending column too much. For a six-feet furnace, and thirty-six-feet air-ways, an upcast of from twenty-five to thirty feet of sectional area would be the approach to perfection. The upcast shaft should be free from falling water, to insure which there should be no hesitation in lining it throughout with incombustible material.

It is of great importance, in building a ventilating-furnace, to guard against the possibility of setting the coal-pillars on fire. This can be well insured by building an outer wall of brick on each side, between the furnace and the pillars. If the roof is fragile, the side walls should be used as pillars for its support. In no case should prop-wood or other combustible material be erected near the furnace. There is never any money lost in the construction of a good and sufficient furnace, and this is equally true of all the other requirements of good mine ventilation. Plenty of fresh air sweeping through every ramification of the mine, and a good track to haul out the coal, are two most important elements in successful mining.

In former times it was the general practice to pass the whole of the air around the workings in a single stream, termed "coursing the air." In fiery mines frequent explosions took place from the gas returning to the furnace in an undiluted state. It would fire in passing through the furnace, and flame backward, like a train of gunpowder, carrying death and desolation in its track. A torrent of water, called the "water-fall," had to be kept constantly on hand at the top of the shaft to be thrown down to extinguish the fire. In the year 1812 Mr. Buddle had his mind intensely occupied with this subject, and he invented the "dumb furnace," splitting the air at the bottom of the downcast shaft, and supplying the furnace with pure, fresh air direct from the surface, the foul return current being sent into the upcast shaft above the furnace fire by means of a dumb drift cut in the roof above the coal. Mr. Buddle was opposed in this plan by the miners, who contended that the air, by being split, would lose its ventilating force, but they were soon convinced to the contrary. This able viewer, who was justly regarded as the foremost miner of his day, continued to perfect this plan of splitting the air, and he divided the main ventilating column into a number of separate splits or divisions, sending each separate current to ventilate a separate section of the mine.

Since Mr. Buddle's time, an improved furnace has been devised by Mr. John Smith, an intelligent mining manager of the North of England. This furnace, also fed with fresh air direct from the downcast, has two brick arches above the fire for the passage of the return air, and has two air-gates, one on each side of the fire, to cool down the temperature between the brick work and the coal. The plan of splitting the air has also been greatly improved of late years.

Air, in its passage along the galleries of a mine, is greatly retarded in its progress by the friction which it encounters from rubbing against the roof, floor, and sides of the mine. The smaller the air-ways, and the further the air has to travel, the greater is the friction to which it is exposed; hence large air-ways move more air with the same ventilating power than small ones; and hence, also, short air-ways, with the same ventilating power, cause a brisker flow of wind than long ones. As it is expensive, and sometimes impossible to enlarge a single air-course so as to admit of a sufficient current for the requirements of the mine, an increased quantity is had by splitting the circulating stream into a number of splits or divisions. The several portions are each taken into different districts of the mine. Although the rubbing surface of the air-ways is not reduced by this means, the area of the air-channel is greatly enlarged, and the velocity of the separated currents is greatly reduced, which reduces the frictional resistance, and so, on the whole, produces a greatly increased current of air.

"Owing to the resistance offered by the shafts," says Mr. Atkinson, "we dare not have more than a limited number of splits in a mine; because, although every split adds to the total quantity of air in circulation, still, in each separate split the quantity ultimately becomes less and less, and if the number be too great, the current of each becomes too feeble and slow to sweep into the holes, corners, and places driven in advance of the actual current; and, besides this, powder-smoke is a long time in being carried away from the workmen. Still, it is a fact that an additional quantity of air, on the whole, is obtained from every new split that is made."

By splitting the circulating current into parts, and ventilating separate districts of a mine with independent splits or divisions of air, the ventilation is not only made purer and better, but in case of an explosion of fire-damp, the force of the blast is confined to the district where it occurs. Every split of the main current should be made as near the bottom of the downcast as possible, and no two or more splits should be allowed to reunite until after they have returned by independent routes towards the bottom of the upcast. By constructing over-throws in the mine, so that one current can pass over another without coming in contact, and by placing regulators in each separate air-course, so as to give each division of the mine its proportionate share of the main current, many a dangerous and fiery mine is made safe and healthy. Where one division or the mine is more dangerous than another, the split can be increased to meet the requirements of the case, and the intelligent manager is constantly borrowing and lending currents, as the demands of the various districts draw upon him.

In mines which are free from discharges of fire-damp, less elaborate arrangements will serve every requirement of health and safety. And for this reason such mines might be supposed to be always in an efficient state of ventilation. Unfortunately, the absence of fire-damp in a mine is too often taken as license for neglect in this matter of ventilation. In many a non-fiery mine the workmen are plunged all day in an almost stagnant and hourly-thickening atmosphere. Too frequently the workmen's lamps can only be kept burning by being hung downwards and to a post or to the pillar side. This condition of things is prompted by ideas of economy—to avoid driving the necessary air-courses, hanging doors, and building stoppings. But this policy of asphyxiating the miners is by no means true economy. The foul air of the mines not only prostrates the energies of the miners, so that they can not do a full complement of work, but it has also an injurious effect on the prop-wood, rails, and other wood-work of the mines, requiring their renewal every few years. Mr. Mackworth, Inspector of Mines, on dividing the quantity of coal brought out by the whole number of men employed in a large number of fire-damp mines, including the non-producing force employed in ventilating, and the quantity of coal brought out in an equal number of mines in which no fire-damp existed, and in which the air was bad, found that the men who wrought in the fiery seams, where good ventilation prevailed, did each considerably more work than those who worked in bad air. It has been estimated that a miner will do fully one-fourth more work in a mine in a good state of ventilation than in one in which the air is allowed to be in an impure state, and many a long and bitter miner's strike has had its origin in the foul and noxious air of the mine.

A number of instruments are used in connection with the ventilation of coal mines, to wit, the thermometer, the barometer, the anemometer, and the hygrometer.

The thermometer is used to ascertain the temperature of the air of mines, and also to find the difference of temperature in the upcast and downcast shafts, so as to be able to calculate the amount of pressure arising from the action of the ventilating furnace, or other power.

The barometer is of great value in giving notice of an increased escape of fire-damp in certain states of the weather. As the fire-damp is pent up by the counterpoising pressure of the atmosphere, any lessening of atmospheric pressure, as indicated by a fall in the mercurial column, is a sure presage of an extra flow of this gas, and calls for an increased volume of air in the mine. The great majority of mine explosions occur during a low state of the barometer. The more sudden the fall of the mercury, the greater is the danger of explosion. Not only does an undue escape of gas take place from the coal strata by a fall of the mercury, but the waste-air of the abandoned parts of the mine—an atmosphere frequently charged with an explosive mixture of fire-damp—expands in volume, and increases the danger of explosion.

The anemometer is used in measuring the amount of air which passes through the mine. Several of these instruments are in use, but Biram's is the favorite, both in Great Britain and the United States. It is an instrument easily understood, and self-registers the velocity of the current. Any slackening of the circulating stream by neglect of the furnace, or by obstruction of the air-ways, is at once detected by the lessening speed of the anemometer. Powder smoke is also sometimes used for ascertaining the speed of the aerial current in the mine.

By means of the hygrometer the proportion of moisture of the air of mines is ascertained. Mason's wet and dry bulb hygrometer is one of the best in use.

APPENDIX.

Columbus, February 1, 1876.

The following circular was sent to every coal firm in the State:

State of Ohio, Office of State Inspector of Mines,
Columbus, December 31, 1875.

Gentlemen: Will you please furnish me on receipt, for publication in my forthcoming annual report, a statement of coal mined, number of men employed, etc., at your works for the year ending December 31, 1875?

The statement of coal mined will not be published except as the aggregate production of the county and State.

Name of mine, ——; county where located, ——; name of coal firm, ——; post-office address of same, ——; average number of men and boys employed on outside, ——; average number of men and boys employed on inside, ——; annual production of coal, ——; list of serious accidents, ——; list of fatal accidents, ——.

Very truly, etc.,

Andrew Roy.

The returns came in very slowly, and some have not been returned up to the present time. The various companies are unusually busy settling up the business of the year. However, as the report did not go to press until the 1st of February, I delayed making any calculation until that time. Statistics are without value if they are not correct. I must add that some of the coal companies are adverse to furnishing a statement of the amount of coal mined by them, and few of them care to have the out-put of their mines published except as forming part of the aggregate yield of the county or State.

The number of fatal accidents which occurred during the year, in and around the coal mines of the State, amounts to twenty-four; twenty-one of the unfortunate persons were killed inside, and three outside. Eleven of these fatal accidents were caused by falls of roof and coal; four were caused by the caving in of a shaft in course of sinking; three by premature explosions; two by being run over by cars; two by falling down shafts, and the other three from other causes. The aggregate amount of people employed in and around the mines is 13,667, of whom 12,096 work in the mines and 1,373 work on top. The amount of coal mined was

4,868,252 tons. Part of the yield was estimated, no returns being sent in from the mines, but the above statement of the out-put of coal is at least approximately correct. One fatal accident, according to the above figures, occurred for every 202,677 tons of coal mined, and for every 561 persons employed.

In 1874 twenty-seven fatal accidents were reported, but three others, one of which occurred in Trumbull county, one in Perry county, and one in Tuscarawas county, were not returned in time for the report. My estimate of the coal production of the State for 1874 was stated at 3,820,000 tons, but later returns showed the out-put to be equal to 4,267,585 tons. The number of persons employed were 12,500. One death was then caused for every 142,252 tons mined and for every 417 persons employed. The number of serious accidents which occurred in 1874 amounted to eighty. This year only forty have been returned. There is, however, a probability that all the serious accidents were not reported, for in mining, as in war, there are three crippled to one killed.

The summary of the statistics of the British inspectors' reports for 1874 shows that with regard to those undertakings which are subject to the "Coal Mines Regulation Act," there were no accidents or deaths during the year in Ireland. In Great Britian there was an average of one fatal accident among every 602 persons employed in and about the mines, and one death by accident among every 510 persons. It will be observed that a "fatal accident" simply counts as one in the returns, although it may kill several persons; hence there is a difference in the ratio, according as we take the accidents or the deaths. It is also shown that 157.222 tons of minerals were mined for each fatal accident, and 133,251 tons for each death. In the preceding year (1873) the fatal accidents and the number of deaths from such accidents were more numerous in proportion to the number of persons employed, there being one accident among 526 persons, and one death from accident among 479. In proportion to the weight of minerals raised, the figures for 1873 showed one accident for 146,867 tons, and one death for 133,677 tons. Thus, on the basis of the work done, there was an improvement last year as compared with 1873 in the ratio of fatal accidents, but in regard to the actual loss of life the ratio was not quite so good as before, though the difference was so slight as to be scarcely appreciable. The fatal accidents from explosions of fire-damp were precisely the same in number last year as in the year preceding, namely, 44. The number of fatal accidents from the breaking of ropes and chains was also the same in the two several years, being 11 in each. In some other instances the two years show almost an exact equality in number of fatal accidents of a specified character.

With regard to the deaths from explosions of fire-damp, the figures show a great increase, being 166 for last year, as against 100 in the year preceding. But, of course, two or three heavy accidents will greatly aggravate the returns under this head for a single year. The deaths from the falls of the roof or sides of the mines show a considerable decrease, being 412 in 1874, as against 491 in 1873. The magnitude of these latter numbers, as compared with those under the head of fire-damp, shows that the terrible catastrophes which create so great a sensation in the public mind, are not the most fruitful source of destruction to the life of the miner. Deaths from accidents in the shaft were 154 last year, and 171 the year preceding. The deaths from miscellaneous accidents under ground were 214, as against 221 in 1873. The loss of life from accidents at the surface showed an increase, the deaths from this cause being 109, whereas in 1873 they were 86. Coming to the total there is a slight decrease, the deaths in 1874 being 1,056, as against 1,069 in the year before. The total number of mines was 4,332, employing 538,829 persons. The tons of minerals "wrought" amounted to 140,713,832, of which 126,590,108 were coal, the remainder being fire-clay, iron-stone and shale.

During the session of the Pennsylvania Legislature in 1870, the law enacted providing for the health and safety of persons employed in the anthracite coal mines of the State, divided the anthracite coal field into six inspection districts, in each of which an inspector of mines was appointed by the Governor. Since the passage of this law a vast amount of valuable and statistical information is annually published in the inspectors' reports. In 1873 the aggregate yield of the mines was 22,032,265 tons; the number of persons killed was 264, and the number seriously injured was 685. These figures show one death in the mines for every 83,457 tons mined, and a serious accident for every 32,140 tons mined. This is a most frightful list of mine casualties, and is greatly in excess of English mines, which for the same year only footed up one death for every 146,869 tons of mineral raised. The number of hands employed in the same year, at all the mines of the anthracite region, was 56,405, showing one death for every 213 hands employed in the same year in and about the mines, against one death for every 479 persons employed in and about the mines of Great Britian. The most dangerous mines of the anthracite region appear to be those of Schuylkill and Northumberland counties; one death being reported for every 52,055 tons mined.

The following gives the number of killed and maimed, etc., in all the anthracite districts in 1874:

	Killed.	Injured.	Widows.	Orphans.
Schuylkill	78	266	36	140
Northumberland	16	92	6	16
Columbia	2	8	....	....
Dauphin	8	16	1	6
Wyoming, Mid	57	105	29	69
" East	69	89	38	112
Lehigh	33	45	20	48
Totals	261	621	130	391
" in 1873	264	685	132	402

The following table gives the whole production in the anthracite regions in 1874, together with the proportion of coal mined for each person killed and maimed during the year:

	Product. Tons.	Death. Tons.	Accident. Tons.
Schuylkill	4,844,922	62,114	21,433
Northumberland	1,374,245	85,889	14,937
Columbia	290,923	145,961	36,365
Dauphin	478,481	59,810	29,280
Wyoming, Mid	4,513,847	79,190	42,084
" East	6,357,885	92,143	71,437
Lehigh	3,641,873	110,366	80,908

The product of all the regions gives one death for every 82,438 tons mined, and 34,647 for each accident.

"The total yield of the mines in Prussia, including salt-works, was, in 1874, 44,347,800 tons, representing a value of £21,480,121, against 45,149,421 tons, of the value of £22,958,301, in the previous year. The year 1874, consequently, shows a decrease, in quantity, of 1.66 per cent.; in value, of 6.44 per cent. The decline was mainly in the production of the iron-ore mines and of the coal mines. The yield of iron fell from 3,555,005 tons in 1873 to 2,540,886 tons in 1774, the latter year thus showing a decrease in the production of no less than 1,014,115 tons, or 28.53 per cent.. Corresponding with this decrease in quantity, there was a decline in value against the previous year of £776,384, and a reduction in the number of miners of 10,747 men. The quantity of coal produced in 1874 amounted to 31,938,683 tons, against 32,347,709 tons the year previous, thus showing a decrease of 409,226 tons, involving a decline in value of £838,037. The decrease in value of the iron and coal production (1874 against 1873) is, consequently, no lesss than £1,614,421, an amount higher than the decrease in value which the production of the Prussian mines, amounting only to £1,478,180, represents. The causes of this phenomenon must be sought in the steady progress of a few other branches of mining—brown coal, lead ore, and zinc ore—which make up for the great deficiency in the iron ore and coal production. The salt-works show a total production for the year 1874 of 4,305,664 cwt. of salt, of the value of £292,118, against 3,822,574 cwt., representing a value of £257,300, the year previous. This is, consequently, an increase in this branch against the preceding year of 483,154 cwt., or 12.64 per cent., of a value of £34,718, or 13.53 per cent. The numbers of the mines at work were as follows:

	In 1873.	In 1874.
Coal mines	506	501
Brown coal mines	577	549
Iron ore mines	1,539	1,121
Zinc, lead, and copper ore mines	262	262
Other mines	79	92
Salt works	32	31
Totals	1,995	2,556

In 1874, therefore, 439 mines (of which 418 were iron-ore workings) and one salt-work less were being worked than the preceding year. The numbers of workmen employed were:

	1873.	1874.
Miners	241,196	239,884
Men employed in salt-works	1,757	1,857
Totals	242,953	241,741

Which is 1,212 men less in 1874 than in 1873.—[*Mining Journal.*

THE STORE-ORDER SYSTEM.

This is an evil which is growing in magnitude, and is deserving the serious attention of the Legislature. Working-men, instead of receiving pay in the lawful currency of the State, are paid in store-orders, or in scrip, at many mines, mills, furnaces, and other industrial establishments. In these dull times, and low wages, it places the working-man in a state of semi-feudalism. The system has already attracted the attention of some of the State Legislatures, and a bill is now before the General Assembly of Pennsylvania requiring that all employes engaged in mining and manufacturing shall be paid in lawful money of the United States, and that goods, wares, merchandise, or commodities of any kind shall not be considered as pay.

I copy the following letter from one of the most intelligent working miners in the State on this subject:

SODOM, TRUMBULL COUNTY, OHIO, *January* 24, 1876.

HON. ANDREW ROY, *State Inspector of Mines, Columbus, Ohio:*

I desire to call your attention to a subject of great importance to the laboring masses of the State, causing much suffering and discontent, and growing in magnitude—the "truck system," as it is generally called.

The mine-owners have a store at the mines, in which the goods kept are, as a rule, of a cheap and inferior kind, but they are sold to miners at the highest figures. The miners, instead of being paid in money, either receive store-scrip or store-orders, which will purchase goods at only one store—that owned or controlled by the coal company. If the company does not own the store, they receive five per cent. back on all orders issued, for giving it the patronage of the mine. The orders read like this: "Mr. A. B., pay to the order of C. D., in merchandise, $5, and charge E. F." This five per cent. comes out of the miner by being added on the goods he purchases, and is equal to two and a half cents per ton of a reduction of wages.

It may be urged that miners are not compelled to purchase goods at this store; but take this case: In the mine where I am working we are paid once a month—that is those of us who have any money coming at pay-day. When a man commences work in this mine he has to wait forty-seven days before he gets his first pay. In these dull times, and low wages, a working-man with a small family *is* compelled to take store-orders or scrip, or starve; for who can wait forty-seven days on pay?

To correct this evil, we want pay every two weeks, so that we can get money and buy for cash; and I would suggest that a law be passed for this purpose. Of course, the employers of labor will exclaim that they can not get money, and that such a law would bring disaster to their interests and to ours. But this law would act like the mining law. *That* law was going to ruin the coal business of the State. So they said. Look at England. Working-men are there paid every week in lawful currency—not in store-orders nor in scrip—and such is the law of the realm, and the money is always forthcoming on pay-day. Every true-hearted laborer, and every honest merchant, would hail the passage of such a law by our Legislature. It would be hailed by the miners as the inspection law was hailed, as good air in their working places is hailed, and as good props under the roof make us feel safe, because it would enable us to go with ready money to the cheapest market to purchase wholesome food and good clothing, and would remove a growing feeling of discontent at the mines. Now, in this year of our Centennial independence, I urge you to bring this matter before the attention of the Legislature.

Very respectfully,

DAVID OWENS.

TRAVELING AND OTHER EXPENSES.

From the day upon which I received my commission, I have been almost constantly employed in the mining regions of the State, visiting and inspecting the mines, to see that the law was enforced and obeyed; making such suggestions for improving the condition and manner of working the mines as would conduce to the health and safety of the miners and to the economy of the mining operators. I knew, unless periodical visits were made to the mines, the law would be of no avail. I have traveled on foot under ground fifteen hundred miles. At every mine I have been received with the greatest courtesy, and every assistance has been given me, on the part of the mine-owners and superintendents, to make a thorough examination of the mine.

My traveling expenses have been made as light as it was in my power to make them. I made conscience of every cent expended, and did for the State what I would have done for myself. Some of the railroad companies extended to me the courtesy of an annual pass; in all cases where I have not been charged railroad fare, I have not charged the State. In passing from one mine to another, I have never hired a horse or a rig of any kind, unless the distance exceeded four miles, but walked on foot.

All opposition to the inspection of the mines by State authority may be said to be now wholly disarmed. After two years of trial, those who were opposed to the law, fearing it would cause trouble and strikes among the miners, have acknowledged their mistake. In visiting a mine, it was not for the purpose of annoying the company or the mine superintendent, but for the purpose of getting the mine improved as the law required; to do good and not evil; to make peace and not strife. I came as a friend, not as an enemy—as the friend of both; and I now receive letters from coal companies requesting me to make visits to the mines, especially those that are thought to be dangerous; for such visits satisfy the miners and allay the feelings of fear.

STATEMENT OF CONTINGENT EXPENSES FOR THE YEAR ENDING DECEMBER 31, 1875.

Date.	For what purpose paid.	Amount.
Jan. 6–14	To visiting mines of Mahoning Valley and Salineville	$31 50
19	To express charges on two lithographs for report	2 25
19–23	To visiting mines at Coshocton and Port Washington	14 30
25–29	To visiting mines at Straitsville and Federal Creek	8 45
31	To express charges on maps, and postage stamps	3 10
Feb. 8–12	To visiting mines at Akron and Wadsworth	17 25
15–20	To visiting mines at Coshocton, Urichsville, and New Philadelphia	18 40
22–23	To express charges on maps	85
23–28	To visiting mines in Medina county	10 25
March 4	To purchasing Inspector's note-book for office	22 00
10	To postage stamps	2 00
15–19	To visiting mines in Mahoning Valley region	12 75
19	To postage stamps	2 20
21	To binding report and purchasing mining-book	5 00
22–26	To visiting mines at Straitsville	5 00
April 5–14	To visiting mines at Steubenville and Bellaire	26 40
14	To postage stamps	1 00
15–18	To visiting Massillon and Coshocton mines	12 40
20–25	To visiting Zanesville and Macksburg mines	15 04
April 27 to May 2	To visiting mines on Muskingum river	15 40
May 2	To postage stamps	3 00
5–10	To visiting mines at Bellaire region	19 50
18–20	To visit to Straitsville mines	4 00
26–31	To visit to Zanesville, Cambridge, and Bellaire mines	19 15
June 9–13	To visit to Vinton county mines	8 45
14–15	To visit to Nelsonville mines	5 85
16–18	" "	5 50
22–24	To visit to Shawnee mines	4 00
24–26	To visit to Wellston mines	5 50
27	To postage stamps	1 50
July 7–17	To visit to Belmont county mines, Steubenville, Ironton, etc	35 40
20–25	To visit to Tuscarawas Valley	22 50
Aug. 1– 6	To visit to Mahoning Valley mines	16 40
16–21	" " "	13 21
23–28	To visiting Coshocton mines	15 90
Aug. 31 to Sept. 5	To visiting Salineville mines	16 40
Sept. —	To postage stamps	3 00
15–23	To visit to Hocking Valley mines	7 65
23	To postage stamps	3 00
Sept. 25 to Oct. 6	To visiting mines of Summit county, North Lawrence, and Canton on law suit	40 40
Oct 8	To express charges on map, and two telegrams	2 35
11–12	To visiting Longstreth's mines	4 50
15–16	To visiting Cambridge mines	7 90
17	To postage stamps	4 00
17–23	To visiting Mahoning Valley mines	16 40
26–29	To visiting Shawnee mines	7 50
Oct. 29 to Nov. 3	To visiting Vinton county mines	6 00
Nov. 3	To two map cases and express charges on same, and entry maps.	13 75
9	To visit to Cleveland on law suit *v.* Mahoning Coal Company	7 50
15–19	To visiting mines of Leetonia and Mineral Ridge	22 75
23–25	To visiting Wadsworth slope	9 50
Dec. 13	To express on reports	1 80
15	To postage stamps	2 00
26	" "	16 25
26–29	To visiting Wadsworth slope	12 40
	Total	$610 48

LIST OF SERIOUS ACCIDENTS.

NAME.	NAME OF MINE.	CAUSE OF ACCIDENT.	NATURE OF ACCIDENT.
John Flannagan	Cleveland shaft	Fall of coal	Leg broke.
A. Swede	Foster shaft	Fall of roof	Back broke.
Pat. Griffith	Beech Hollow	Fall of slate	Back broke.
I. Graham	Coshocton	Fall of slate	Injury not stated.
Dan. Pascoe	Newark Coal Company	Fall of coal	Seriously bruised.
John Tares	Lick Run	Fall of car	Seriously hurt.
Ed. McConachy	Scott's mines	Riding on loaded car	Hurt in back and side.
Geo. Lark	Minersville	Riding on cars	Crushed badly.
Ben. Lewis	Dabney	Fall of slate	Back and limbs.
John Burns	Wadsworth slope	Premature blast	Head and breast.
John Ballantine	Sodom slope	Fall of slate	Back and limbs.
I. French	Sodom slope	Fall of slate	Back and limbs.
Thos. Rosdoer	Shenango slope	Fall of coal	Leg broke.
Anthony Broadis	Longstreth mine	Caught between cars	Body bruised.
De Witt Washburn	Longstreth mine	Fall of roof	Body bruised.
Geo. Swindle	Longstreth mine	Caught between cars and pillar	Body bruised.
John Flannagan	Central mine	Fall of coal	Body bruised.
David G. Roy	Central mine	Run over by cars	Leg broke.
Jos. Woodward	Farmers' mine	Fall of coal	Collar-bone broke.
Adam Rhinehart	Johnson shaft	Fell under engine	Injury not stated.
Geo. Washburn	Longstreth mine	Fall of slate	Injury not stated.
David Vaughn	Syracuse slope	Fall of slate	Injury not stated.
Eli Cook	Wellston shaft	Fall of slate	Thigh broke.
John McCulloch	Star Furnace shaft	Explosion of fire-damp	Face and arm bruised.
John Cochrane	Star Furnace shaft	Explosion of fire-damp	Face and arm bruised.
Henry Bowen	Vienna	Caught between cars	Injury not stated.
Wm. Young	Wheeler slope	Premature blast	Face and head crushed.
August Turncout	Wheeler slope	Fall of slate	Face and head crushed.
John Disclin	Del Carbo	Fall of roof	Face and head crushed.
Thos. Davis	Johnson shaft		Hand crushed.
Crist. Wheat	Pittsburgh Works	Sinking shaft	Back hurt.
A. McElheny	Pittsburgh Works	Sinking shaft	Back hurt.
Jas. Hemclin	Martin's Ferry	Fall of slate	Not stated.
John Mossop	Burton City	Fall of roof	Back hurt.
Richard Gorman	Maple Grove	Fall of roof	Back hurt.
Jas. Shenard	Shawnee	Fall of coal	Leg broke.
Wm. Nesbet	Long bank	Fall of coal	Body and limbs.
Phil. Carosella	Long bank	Fall of coal	Body and limbs.
John Schloser	Buckeye	Fall of slate	Back hurt.
John Pruthers	Pomeroy	Premature blast	Face and breast.

LISL OF FATAL ACCIDENTS.

DATE.		NAME.	NAME OF MINE.	CAUSE OF ACCIDENT.
1875.				
March	4	Petereen Bianka	Church Hill	Fell down shaft.
	6	Henry Ohlinger		Fall of slate.
	15	Anthony Whalen	Shawnee	Run over by cars (outside).
April	12	John Shenhalter, Peter Shenhalter, George Orr, and Peter Adams	Pigeon Run shaft, Massillon	Caving in of shaft.
		William Carlisle	Helen's mine	Fall of earth (outside).
July	1	James Patterson	Pittsburgh Works	Fall of roof.
		George Fry	Pittsburgh Works	Fall of roof.
Aug.	17	Joseph Stitts	Salineville	Fall of trestle (outside).
	23	Frank Fox	Packard slope	Fall of roof.
Sept.	1	John Rice	Kyle shaft	Premature blast.
	3	M. Sprague		Fall of roof.
	22	C. Cubers	Burnett slope	Fall of roof.
	28	Henry Benin	Massillon Coal Company	Fall of slate.
	30	Jacob Miller	Rhodes shaft	Fell down shaft.
Oct.	8	David Cummins	Longstreth mine	Fall of roof.
	12	James Harris	Longstreth mine	Fall of slate.
	22	James McIntosh	Pennel slope	Premature blast.
Nov.	6	Thomas B. Thomas	Brookfield slope	Fall of rock.
Dec.	27	Gatanes Reetz	Stewart mine	Explosion of powder.
	28	William Flint	Rush Run	Fell down shaft.

STATEMENT OF NUMBER OF MINERS AND AMOUNT OF COAL MINED IN THE SEVERAL COUNTIES DURING THE YEAR 1875.

Counties.	No. of Miners.	Production in tons.	No. of drifts.	No. of slopes.	No. of shafts.	Total number.
Athens	887	329,503	12	0	4	16
Belmont	514	213,955	10	5	1	16
Carroll	150	60,000	5	1	1	7
Columbiana	967	332,446	18	1	1	20
Coshocton	251	90,669	9	0	0	9
Guernsey	295	135,425	4	0	1	5
Gallia	20	5,420	2	0	0	2
Hocking	429	170,034	3	0	0	3
Holmes	40	14,000	1	0	0	1
Harrison	10	5,300	1	0	0	1
Jefferson	465	195,265	7	0	13	20
Jackson	267	117,730	3	1	7	11
Lawrence	355	122,484	5	0	0	5
Medina	228	80,000	0	2	0	2
Mahoning	774	271,689	2	9	8	19
Muskingum ‖	380	109,480	10	0	1	11
Meigs	917	345,500	11	1	2	14
Noble	30	4,000	1	0	0	1
Perry	1,236	503,169	24	0	0	24
Stark	795	408,180	1	5	12	18
Summit	735	274,876	3	6	2	11
Tuscarawas	358	107,000	9	0	2	11
Trumbull	2,551	749,059	1	20	6	27
Vinton	225	56,356	4	1	0	5
Wayne	240	80,291	2	0	2	4
Washington	72	12,425	3	0	0	3
Small mines	300	80,000				
Totals	13,669	4,868,252	151	52	63	266

LIST OF MINES, TOGETHER WITH NAMES OF OPERATORS, ETC.

Athens County.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Lick Run	Drift	I. W. Scott	I. W. Scott	Nelsonville.
Laurel Hill	“	T. P. Marshall	Laurel Hill Coal Co	Bretland.
Section 29	“	Wm. Comstock	W. B. Brooks & Son	Nelsonville.
Harper's	“	Benj. Harper	Harper Brothers	Nelsonville.
Co-operative	“	John F. Welsh	Nelsonville Mining Co	Nelsonville.
Poston's	“	John Burbury	Poston Brothers	Nelsonville,
Longstreth's	“	Thomas Berry	T. Longstreth	Nelsonville.
Star	“		Star Mining Co	Nelsonville.
Doanville	“	John McGinnity	N. Y. & O. Coal Co	Nelsonville.
Floodwood	“	Joseph Wolf	B. B. Sheffield & Bro	Floodwood.
Hamley's Run	Shaft	Wm. Cornell	G. F. Gould	Athens.
Salina	“	G. F. Gould	“	Athens.
Chauncey	“			
Big Run*	“	I. Morrow	Federal Creek Coal Co	Big Run.
Carbondale	Drift	Joseph Armstrong	Carbondale Coal Co	Mineral City.
King's	“	D. McDermott	King Brothers	King's Switch.

Belmont County.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Barnesville	Shaft			
Steward's	Drift	Stewart & Mehan	Stewart & Mehan	Stewardsville.
Kidd's	“	John Kidd	Kidd Brothers	Shields.
Rainey's	“	Thomas John	W. J. Rainey & Co	Cleveland.
Etna	“	Ed. Herbert	Etna Iron and Nail Co	Martin's Ferry.
Helling's	“	Henry Helling	Henry Helling	Martin's Ferry.
Ohio City	“		Ohio City Iron and Nail Co	Martin's Ferry.
Belmont Works No. 1	“	Jacob Heatherington	Heatherington Brothers	Bellaire.
Belmont Works No. 2	“	same	“ “	Bellaire.
Pittsburgh Works	Slope	John Hines	Rochinhouser & Sterrett	Bellaire.
Empire	“		Thomas Corcoran	Shawnee.
Weegee	“	Thos. Jones	P. Shafar & Co	Weegee.
Union Works	“	C. Cunningham	Union Coal Co	Moundsv', W.Va.
Pipe Creek	“	Wm. Babel	Pipe Creek C. and I. Co	Dilley's Bottom.
Barnard's	Drift	Thos. Nicholson	W. G. Barnard	Bellaire.
Morgan's	“	S. W. Coss	E. G. Morgan	Bellaire.

‖ The estimated production of this county includes small mines.

CARROLL COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Robertsville No. 1	Drift	Thos. Yates	Cleveland Iron Co	Salineville.
Robertsville No. 2	"	same	" "	Salineville.
Brown's Strip Vein*	"	Mathew Brown	Mathew Brown	Salineville.
Brown's Big Vein*	"	same	"	Salineville.
Dutchen & Davis	"		Dutchen & Davis	Salineville.
Tunnel Hill	Shaft		I. C. Card	Cleveland.
Welsh Mines	Slope	T. Brickmann	McDowell & Pratt	Mineral City.

COLUMBIANA COUNTY.

Washingtonville No. 1	Drift	Zack Titlow	Cherry Valley Iron Co	Leetonia.
Washingtonville No. 2	"	same	" "	Leetonia.
Leetonia Slope	Slope	same	" "	Leetonia.
Grafton	Shaft	Frank Rooney	Grafton Iron and Coal Co	Leetonia.
Empire	Drift	Wm. Houston	John Hayes & Co	Salineville.
Hayes'	"	Jacob Smith	" "	Salineville.
Farmer's	"	Geo. H. Sharp	Jas. Farmer	Salineville.
Hartford	"	Edmund Boyle	O. and P. Coal Co	Salineville.
Rockville	"	James Black	" "	Salineville.
O. and P.	"	same	" "	Salineville.
Granage & Anderson	"	James Smith	Manufacturers Coal Co	Salineville.
Foster	"	Sampson Sharp	Harding & Sharp	Salineville.
Hussey Hollow	"		O. and P. Coal Co	Salineville.
Truesdale	"		Truesdale Coal Co	Salineville.
Robins'	"	H. H. Bowmann	New Lisbon Coal Co	New Lisbon.
Foster Mine	"		Shields Coal Co	Teegarden.
Rose Mine	"		Thomson & Coleman	Teegarden.
State Line	"		State Line Coal Co	East Palestine.
Prospect Mines	"		Prospect Coal Co	East Palestine.
O. and P.	"		O. and P. Coal Co	Salineville.

COSHOCTON COUNTY.

Union	Drift	W. S. Wood	Union Coal and Mining Co	Coshocton.
Blaen Nant	"	Ed. Prosser	Edward Prosser	Coshocton.
Rock Run	"		Rock Run Coal Co	Coshocton.
Summit	"	L. L. Scott	Franklin and Coalport Coal Co.	Coshocton.
Coshocton	"	Jas. E. Evans	Coshocton Coal Co	Coshocton.
Diamond	"		Diamond Coal Co	Coshocton.
Cunesville	"		Ressler & Co	Newark.
Pen Twyn	"	Ed. Prosser	Pen Twyn Coal Co	Coshocton.
Home	"	same	Home Coal Co	Coshocton.

GUERNSEY COUNTY.

Scott's	Drift	Jas. C. Wilson	Scott Coal and Salt Works Co.	Cambridge.
Cambridge	"		Cambridge Coal and Mining Co	Cambridge.
Central	Shaft	Wm. Norris	Wm. Norris	Cambridge.
Nicholson	Drift		Ohio Coal Co	Marietta.
Guernsey	"		Guernsey Mining Co	Cambridge.

GALLIA COUNTY.

Leadington	Drift		Leadington Coal Co	Cheshire.
Cheshire	"	C. A. Card	Cheshire Coal Works Co	Cheshire.

HOCKING COUNTY.

Section 19	Drift	Wm. Comstock	W. B. Brooks & Son	Nelsonville.
Hayden's	"	T. Jones	Peter Hayden	Haydenville.
Gore*	"		Straitsville and Monday Creek Coal Mining Co	Gore.

HOLMES COUNTY.

Hardy	Drift	Jas. Conner	Hardy Coal Co	Millersburg.

HARRISON COUNTY.

Philadelphia	Drift	W. E. Williams	Philadelphia Coal Mining Co	Station 15.

JEFFERSON COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Market Street	Shaft	Wm. Smurthwaithe	Steubenville Coal Mining Co	Steubenville.
Stony Hollow	"	same	" " " "	Steubenville.
Gravel	"	Jas. Duffy	Steubenv' Furnace and Coal Co	Steubenville.
Everick's	"	John Smurthwaithe	O. and P. Coal Co	Steubenville.
Boreland's	"	Thos. Ritson	Cincinnati Coal and Coke Co	Steubenville.
Rolling Mill	"	Robt. Thomson	Spaulding, Woodward & Co	Steubenville.
Mingo	"	John Cram	Mingo Iron Works Co	Mingo.
La Grange	"	John Lowe	La Grange Coal Co	Philipsburg.
Rush Run	"	John Nicholson	Peck & Ramsey	Rush Run.
Bustard's	"	Thos. McNamee	Steubenville Coal and Coke Co.	Steubenville.
Alikana	"	John Knox	Bell & Co	Steubenville.
Cable*	"			
Irondale No. 1*	Drift		Morgan Iron Co	Irondale.
Irondale No. 2*	"		" "	Irondale.
Irondale No. 3*	"		" "	Irondale.
Hammondsville*	"		Hammondsv'e Coal and Coke Co	Hammondsville.
Strip Vein	Shaft	H. W. Wallace	Wallace & Sons	Hammondsville.
Diamond	Drift	same	" "	Hammondsville.
Strip Vein*	"		Morgan Iron Co	Irondale.
Big Vein*	"		" "	Irondale.

JACKSON COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Wellston	Shaft	J. Stewart	Wellston Coal and Iron Co	Wellston.
Milton	"	John Hall	Milton Furnace and Coal Co	Wellston.
Star	"	Henry Price	Star Furnace Co	Jackson.
Tropic	"		Tropic Furnace Co	Jackssn.
Orange	"		Orange Iron Co	Jackson.
Globe	Slope	Jas. Harper	Globe Iron Co	Jackson.
Huron	Shaft	D. S. Jones	Huron Iron Co	Jackson.
Erie	"		Erie Iron Co	Jackson.
Jackson Hill	Drift	Price Brothers	Price Brothers	Jackson.
Petrea	"		Petrea Coal Co	Jackson.
Jackson Hill	"	Thos. M. Kitrick	Thos. M. Kitrick	Jackson.

LAWRENCE COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Sheridan	Drift	Henry Pickering	Sheridan Coal and Iron Co	Sheridan.
Hanging Rock	"	E. B. Williard	Means, Kyle & Co	Ironton.
Bellford	"		Norton Bros. & Co	Ironton.
Old Mill	"	Thomas Winters	Iron and Steel Co	Ironton.
Lawrence	"	George Watson	Lawrence Iron Works Co	Ironton.

MEDINA COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Wadsworth	Slope	Philip Reese	Wadsworth Coal Co	Akron.
Diamond	"	H. Coleman	Humphrey & Coleman	Akron.

MAHONING COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Foster	Shaft	Jonathan Head	Foster Coal Co	Youngstown.
Osburn	"	Alex. McIntosh	Andrews Bros	Youngstown.
Kyle	"	Jonathan Oatey	Kyle Coal Co	Youngstown.
Wick and Wells†	"	Evan Edwards	Wick and Wells	Youngstown.
Austin	"	James Jones	John Morris & Co	Mineral Ridge.
Ohltown	"	David Jones	Harris & Maurer	Mineral Ridge.
McKennie's Shaft	"	David Williams	J. B. Warner & Co	Mineral Ridge.
Tibbett's Shaft	"	Jacob Williams	Junction Coal Co	Mineral Ridge.
Foulk's	Slope	R. Perkins	Foulk Coal Co	Mineral Ridge.
Pennel	"	Frank McIntosh	New Lisbon Coal Co	Youngstown.
Haroff	"	James Jones	Haroff Coal Co	Youngstown.
Thorn Hill	"	Abel Dore	Powers and Arms	Youngstown.
Packard's	"	Jacob Henry	Packard Coal Co	Youngstown.
Powers's	"	Clark Powers	Powers Coal Co	Youngstown.
Holland	Drift	Reese Charles	Charles Moore & Co	Youngstown.
Jackson	Slope	George Head	Jackson Coal Co	Youngstown.
Reno's	"			
McKenny Slope	"	John Jones	Mahoning Coal Co	Youngstown.
Walter's	Drift	—— Walters	Walters & Sheets	Washingtonville.

MUSKINGUM COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. Address.
Zanesville Mines	Drift	John Marpool	John Marpool	Zanesville.
Del Carbo	“	B. F. McCloud	Diamond Mining Co	Roseville.
Muskingum Valley	“	J. E. Downing	Muskingum Valley Coal Co	Roseville.
Matthew's	“	Lewis Matthews	Lewis Matthews	Zanesville.
Monitor	Shaft	Hiram Cowell	Cowell, Harris & Co	Zanesville.
Locust Grove	Drift	James Owens	James Owens	Putnam.
Harper's Ferry	“	James Morrison	James Morrison	Putnam.
Ballou's	“	Orin Ballou	Orin Ballou	Zanesville.
Scarval's	“	G. Scarval	G. Scarval	Philo.
Crow Run	“	Charles Stone	Stone & Deval	Cedar Run.
Blue Rock	“	James Paterson	James Paterson	Blue Rock.

NOTE.—There are from twenty-five to thirty other mines in this county, in the neighborhood of Zanesville, but they all work less than ten men at once.

MEIGS COUNTY.

Antiquity	Shaft		Ohio Coal Co	Racine.
Syracuse Shaft	“	John Blair	Syracuse Coal and Salt Co	Syracuse.
Syracuse Slope	Slope	M. Nye	M. Nye & Sons	Syracuse.
Pamunky	Drift		Pomeroy Coal Co	Pomeroy.
Williams's	“	Evan Williams	Evan Williams	Minersville.
Minersville	“	Thomas Middleton	Pomeroy Coal Co	Pomeroy.
Excelsior	“	same	“ “	Pomeroy.
Pencreek	“	same	“ “	Pomeroy.
Dabney	“	same	“ “	Pomeroy.
Diamond	“	same	“ “	Pomeroy.
Coal Ridge	“		Coal Ridge Salt Co	Pomeroy.
Buckeye	“		Buckeye Salt Co	Pomeroy.
Middleport	“		Middleport Salt Co	Middleport.
Pomeroy's	“	Thomas Hedley	S. M. Pomeroy	Pomeroy.

NOBLE COUNTY.

Dexter	Drift	A. Wyper	Ohio Coal Co	Marcella.

PERRY COUNTY.

Central	Drift	David W. Roy	Straitsville Central Mining Co.	New Straitsville.
Old Straitsville	“	Ed. Martin	Straitsville Mining Co	New Straitsville.
Plummer Hill	“	John Sines	Straitsville Coal Co	New Straitsville.
Troy	“	Wm. Job	Straitsville Coal and Iron Co	New Straitsville.
Hillyer's *	“		Lancaster & Str'tsv'e Coal Co.	New Straitsville.
Mungen's	“	Wm. Gibson	Great Vein Coal and Iron Co	New Straitsville.
Youart's	“	R. Youart	Patterson Coal Co	New Straitsville.
Upton's	“	Reese Williams	Card and Upton Coal Co	Shawnee.
Upton's Mines, Nos. 1, 2, 3	“	James Findlay	Newark Coal Co	Shawnee.
New York	“	Sam Butts	N. Y. and Straitsville Coal Co	Shawnee.
Lyonsdale	“	Thomas Corcoran	S'ts'e & Cannel C. Co., of N. Y.	Shawnee.
Furnace	“	Rob Pearson	Furnace Coal Co	Shawnee.
Shawnee Valley	“		Shawnee Valley Coal Co	Shawnee.
Taygue's	“	P. Taygue	M. & P. Tague	McLuny's.
Jones's	“	H. Jones	H. Jones & Co	McLuny's
Tunnel Hill	“		Tunnel Hill Coal Co	New Lexington.
Selby	“		Selby Mining Co	New Lexington.
Wales's	“		Wales, Nugent & Co	New Lexington.
Crookville	“	L. S. Haworth	Palmer & Haworth	Crooksville.

NOTE.—There are three other mines in this county, but the names are not known.

STARK COUNTY.

Fulton	Slope	Sam. Foultz	Fulton Coal Co	Canal Fulton.
Buckeye	“	Andy Harwick	Buckeye Coal Co	Canal Fulton.
Crawford	Shaft	Frank Millhoff	Crawford Coal Co	Massillon.
Crawford	Slope	Dan. Roderick	“ “	Massillon.
Willow	“	Jas. Brown	Willow Bank Coal Co	Massillon.
Willow	Shaft	same	“ “	Massillon.
Williamson	“	R. Donald	A. B. Williamson	Massillon.
Maple Grove	“	John Moore	Massillon Coal and Mining Co.	North Lawrence.
Aberdave	“	John Rosser	Youngstown Coal Co	Massillon.
Jacobs	“	Rinehart Keller	Rhodes Coal Co	Massillon.
Grove	“	H. D. Merryman	Grove Coal Co	Massillon.
Massillon Coal Co	“		Massillon Coal Co	Massillon.
Staeffer	Drift	S. Hands	J. P. Burton	Massillon.
Warrington	Shaft	Chas. Brenkard	Warrington Coal Co	Massillon.
Brookfield	“	H. Foultz	H. Foultz	Massillon.
Pigeon Run	“	Matthew English	Lee, Howell & Co	Massillon.
Lawrence	“	Andrew Praeter	J. P. Burton	Massillon.
Foultz's	Slope	Casper Hyman	Massillon City Coal Co	Massillon.

SUMMIT COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Crawford's	Drift	Frank Millhoft	Crawford & Co	Akron.
Franklin	Slope	I. Hoover	Franklin Coal Co	Akron.
Summit	"	Philip Reese	Summit Mine Coal Co	Akron.
Brewster Slope	"		Brewster Coal Co	Akron.
Brewster Drift	Drift		" "	Akron.
Brewster Bros	Slope	John H. Jones	Brewster Bros	Middlebury.
Middlebury Shaft	Shaft	John Beese	Middlebury Coal Co	Middlebury.
Johnson Shaft	"	Mordecai Morris	Johnson Coal Co	Middlebury.
Dennison*	Drift		Dennison Coal Co	Sherman.
Nemisilla	Slope	George Smith	Nemisilla Coal Mining Co	Cleveland.
Norton's	"		Norton Coal Co	Sherman.

TUSCARAWAS COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Black Vein*	Drift	Joseph Morris	Black Vein Colliery Co	Dennison.
Dennison*	"		Dennison Colliery Co	Dennison.
Andraes Mine	"	S. W. Andraes	S. W. Andraes & Co	Urichsville.
Stillwater	"	J. Fuller	Tuscarawas Valley Coal Co	N. Philadelphia.
Syracuse	"		Syracuse Coal Co	Urichsville.
Pike Run, No. 1	"	John Davis	Tuscarawas Valley Coal Co	N. Philadelphia.
Pike Run, No. 2	"	same	" " "	N. Philadelphia.
Rich Hill	Shaft	T. C. Snyder	Rich Hill Coal Co	Waynesburgh.
Walton Ridge	Drift	Sam. Foultz	Buckeye Coal and Coke Co	N. Philadelphia.
Port Washington	"	Wm. Rennie	Glasgow and Port Washington Iron Co	Port Wash'gton.
Urichsville Shaft*	Shaft			

TRUMBULL COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Vienna	Shaft	John Rosser	Vienna Coal and Iron Co	Youngstown.
Wheeler	Slope	Wm. Phillips	" " "	Youngstown.
Tyler	"	J. McIntosh	C. H. Andrew & Bro	Youngstown.
Halliday	"	Geo. Hornicle	Halliday Coal Co	Youngstown.
Hood	"	Thos. D. Phillips	Arms & Wick	Youngstown.
Sodom	"	Thos. J. Jones	McCurdy Coal Co	Youngstown.
Church Hill Slope	"	Thomas Williams	Church Hill Coal Co	Youngstown.
Church Hill Shaft	Shaft	Ben. Morris	Niles Coal Co	Youngstown.
Kline	Slope	William Parker	Brier Hill Iron Co	Youngstown.
Moore*	"	Edward Powers	Moore Coal Co	Youngstown.
Shenango	"	Thos. Maxwell	Shenango Coal Co	Wheatland, Pa.
Brookfield	"	John Jones, 2d	Brookfield Coal Co	Sharon, Pa.
Burnett	"	G. Cramer	Burnett Coal Co	Youngstown.
Jacobs ‡	Shaft	David Williams	Jacobs & Son	Youngstown.
Carbon Valley‡	Slope	Joseph Edwards	Wick, Struthers & Co	Youngstown.
Stewart	"	Chas. Herbert	Mahoning Coal Co	Youngstown.
Long Bank	"	same	" "	Youngstown.
Mahoning, No. 3	"	same	" "	Youngstown.
Chew	"	same	" "	Youngstown.
Cleveland	Shaft	T. Meredith	Payneheathen & Co	Cleveland.
Ashland	Slope	W. T. Williams	Ward, Warner & Co	Mineral Ridge.
Weathersfield	Shaft	Thos. Morris	Wise Coal Co	Mineral Ridge.
Cambria	Slope	Wm. Edwards	Ward, Warner & Co	Mineral Ridge.
Love	"	Abner Lane	Andrews & Hitchcock	Youngstown.
Williams	Shaft	David Williams	D. Williams & Co	Hubbard.
Winfield	Slope	C. H. Gilman	Winfield Coal Co	Mineral Ridge.
Curtis Hill	Drift	Thos. Bailey	Curtis & Boyce	Sharon, Pa.

VINTON COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Vinton	Shaft		Bancroft & Rader	Vinton Station.
Coalmont	Drift		Zaleski Coal Co	Zaleski.
Zaleski	"		" "	Zaleski.
Vinton	"		Vinton Coal and Iron Co	Vinton.
Moundville Mine	"		Richard Coe	Moundville.
Buckeye	"		Ingham Coal Co	King's Switch.

WAYNE COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Fairview	Shaft	Andrew Praeter	J. P. Burton	Massillon.
Crawford †	Drift	Frank Millhoff	Crawford, Scott & Co	Massillon.
Silver Creek, No. 1	"	Wm. Callin	Silver Creek Mining Co	Doylestown.
Silver Creek, No. 2	Shaft	same	" "	Doylestown.

WASHINGTON COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Washington*	Drift		Washington Coal Co	Youngstown.
Cliff Mines	"	G. W. Linn	G. W. Linn	Coal Run.
Macksburgh	"	A. Wyper	Ohio Coal Co	Marietta.

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* Idle. † Drowned. ‡ Worked out.